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Exotic Viburnums Provide Colorful Understory

Saving Energy With Trees and Landscaping

ISSN 0043-1753

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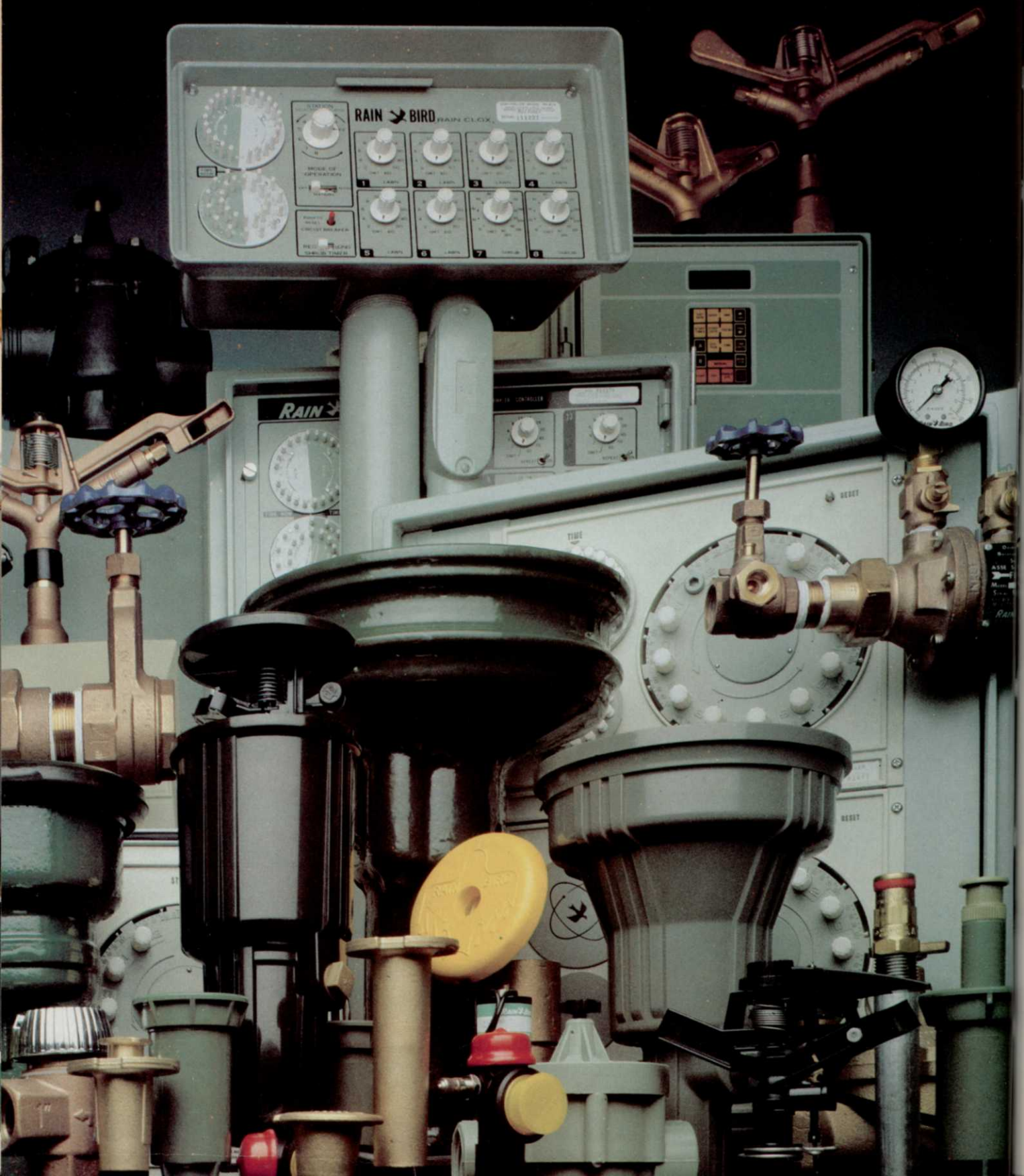

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Bruce F. Shank
Editor
John Kerr
Associate Editor
Robert Andresen
Graphics Director
Maxine Hagen
Production Manager
Agnes Aspling
Circulation Supervisor

Business

ATLANTA
Dick Gore, National Sales Manager
Ron Kempner, Regional Sales Manager
3091 Maple Drive
Maple Center One Building
Atlanta, GA 30305
(404) 233-1817.

CHICAGO
111 East Wacker Drive
Chicago, IL 60601
(312) 938-2300

NEW YORK
757 Third Ave.,
New York, NY 10017
(212) 421-1350

SEATTLE
Robert A. Mierow
1333 N.W. Norcross
Seattle, WA 98177
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Member; American Business Press, Business Publications Audit, National Golf Foundation, American Sod Producers Association, Associated Landscape Contractors of America, National Landscape Association, Horticultural Research Institute.

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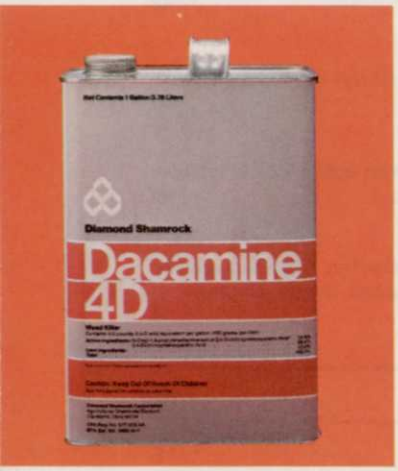
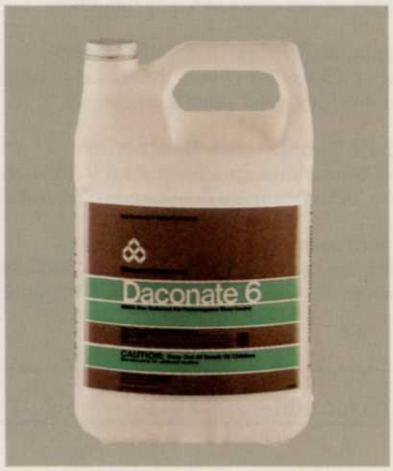
How to get better turf next season.





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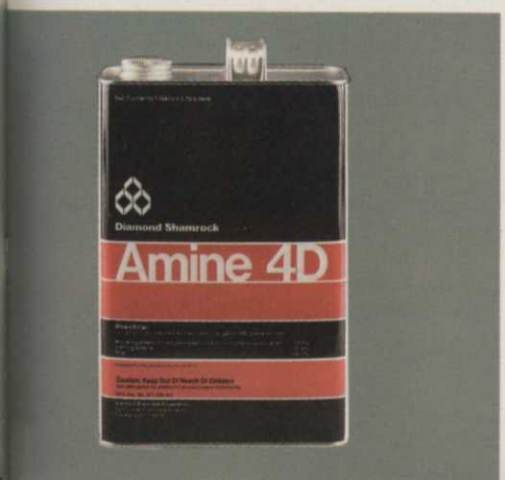

WT&T

OUTLOOK

By Bruce F. Shank, Editor

The value of energy is causing a change in demand. Conventional fireplaces are being replaced with more efficient devices. Builders use smaller windows or double-paned windows in construction of new, energy efficient homes. Even the Internal Revenue Service has created a new deduction for taxpayers to encourage use of energy saving devices.

Homeowners and businessmen are investing in energy conservation to insulate themselves from future energy price increases. However, they often overlook one of the biggest factors in energy conservation, the natural surroundings of a structure. Properly promoted, this area of energy conservation may represent the largest single opportunity for growth of landscape construction and maintenance companies.

The opportunity is not limited to landscape contractors. Landscapes for energy efficiency can be utilized by golf courses, parks, shopping centers, and cities to save money AND improve the appearance of an area at the same time. There isn't a sector of the Green Industry that can't participate in this new area of growth.

Landscape architects should place strong emphasis on energy efficient landscapes. Some conflict between aesthetics and energy efficiency may arise, but basically no one can turn their back on this area of concern to the public.

In this issue of *Weeds Trees & Turf*, we present a number of articles to help illustrate the potential for more energy efficient landscapes. Energy saving landscapes was a major topic at the most recent Ornamentals Northwest Show in Seattle. They are also the subject of a book to be released this March by Moffat and Schiler of Cornell University.

As we face a possible flat year, we have a new card to play. Energy evaluations of landscapes are a good start. Hopefully this could pay off in new construction business from both residential and commercial accounts. It is not cold opportunism. It is application of an overlooked area of technology which can save your customers money in the long term.

The landscape is no longer valued merely by its pleasant appearance, soundproofing, or abstract additional value to the price of property. It can be measured in terms of gallons of oil, cubic feet of gas, and kilowatts of electricity, and these numbers carry more weight than the dollar at present. Ask the customer to divide his energy costs by three. Then tell him you can possibly cut his bills by that much by planting attractive plants on his property. Back it up with the articles in this issue. If you can get the customer to think two or three years ahead, you may be able to gain new business equal to one year's energy cost for that account.

Like anything else it is an opportunity for the con artist selling poor quality plants, planting them poorly, and leaving town. Even though a planting may save energy costs, it also adds to maintenance costs if not properly designed and specified. Advancements in disease and insect resistant plants should be combined with the knowledge of energy conservation. Attention to design for aesthetic reasons should be maintained. Without control we could return to the house surrounded by unattractive barricades of plant material. There are trade-offs still and some compromises may be needed to achieve both aesthetic and energy conservation goals.

Nevertheless, the opportunity is worth the challenge and extra effort. It also teaches us an area of landscaping we should have known all along. **WTT**

WT&T

LETTERS

"Dutch Elm" hits target

My congratulations to you for the publication of the thoughtful and well written article by Hart on the very serious problem of Dutch Elm Disease ("Tragedy of Dutch Elm Disease Bears Hope for Modern Control" by John L. Hart, November). Hart evidently has studied the problem carefully. His presentation is excellent in my opinion.

For what it is worth, you may give some weight to the above. I led the research on the disease for the U.S.D.A. for about 35 years.

Respectfully,
Curtis May

Benefits from magazine

Upon reading your 'Outlook' column in the November issue of WTT, it prompted me to write to you about your magazine. I find your magazine to be extremely beneficial to me and my department. It seems like every time I am thinking about a project or a variety of tree or research information, I receive a copy of WTT and there it is, all my questions answered. You have an excellent magazine.

Sincerely,
John Andrew Fik
Landscape Supervisor
Darien Lake Fun Country

Objects to chlordane

Dear Dr. Funk:
In the November 1980 issue of Weeds Trees & Turf, a pest control service person asked how to get rid of crayfish. Your answer was to check with the local Cooperative Extension Agent on the status of chlordane. Velsicol Chemical Company, the sole U.S. producer of chlordane, agreed to voluntarily cancel most uses of chlordane, effective March 6, 1978. The only uses not cancelled were termite control and dipping of roots and tops of non-food plants. Unless the service person could obtain some chlordane manufactured and labeled prior to March 6, 1978, it would be illegal to use chlordane in such a manner.

In view of this fact and the cancellation of lawn uses of chlordane other than for termites, I feel that another chemical should have been recommended instead of chlordane.

Sincerely,
Amy E. Brown
Assistant Pesticide Coordinator

When this low-growing, Swedish lawn beauty first stepped into the turf world it revolutionized the lawn industry.

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GREEN INDUSTRY NEWS

First lawn care conference pleases suppliers, delegates

Hot on the heels of what many exhibitors and lawn care businessmen called "the best show we've ever attended," the Professional Lawn Care Association of America (PLCAA) has finalized plans for next year's conference and show — to be held Nov. 18-20, again at the Commonwealth Convention Center in Louisville.

More than 700 lawn care businessmen traveled from all over the country to attend PLCAA's first annual conference and show. This figure does not include representatives from the more than 50 exhibiting companies who filled close to 100 booths.

Exhibitors were happy, especially Lakeshore Equipment & Supply Co., Elyria, OH, and Professional Turf Specialties, Normal, IL. Lakeshore wrote over $1 million worth of orders on the show floor, and Professional Turf sold its demonstration truck right off the floor. Dan Duncan and Ed McKinzie of Apex Pest Control & Lawn Care, Inc., picked up the keys to the 1,200-gallon-tank spray truck following the show and drove it home to Bradenton, FL.

Standing-room-only education sessions were the rule for the three-day conference, including excellent presentations by Gordon Ober, Dr. Roger Funk and Jerry Faulring. Ober, general manager of Davey Lawnscape Service, Kent, OH, brought the house down with a comical yet informative slide presentation on employee training. The final-session talk by Davey research director Dr. Funk on pesticide use in the 1980's kept attendees in their seats until the end. And Faulring outlined a blueprint for the lawn care industry with his "Issues You Can't Avoid in the 1980's." Faulring, of Hydro Lawn, Gaithersburg, MD, was elected president at PLCAA's first annual business meeting.

Elected as vice president was Douglas Baker of Leisure Lawn, Dayton, OH, John Latting of Lawn Groomer, Normal, IL, was elected secretary-treasurer. Elected to the board of directors were: Larry Brandt, Spray-A-Lawn, Cincinnati, OH; Don Burton, Lawn Medic, Bergen, NY; Steve Derrick, Latick, Inc., Normal, IL; Rick Eldred, A-Perm-o-Green Lawns, Austin, TX; Dr. Robert Miller, Chem-Lawn Corp., Columbus, OH; Davey's Ober; Dr. Paul Schnare, Atkins Lawn Care, Columbia, MO; Richard White, Village Green Lawns, West Chicago, IL; and Ronnie Zwiebel, Chem-Care Lawn Service of Birmingham, AL. Robert Earley, editor/publisher of LAWN CARE INDUSTRY was named industry liaison.

For information about attending or exhibiting at next year's PLCAA Conference and Trade Show, contact: Jane Stecker, PLCAA, Suite 1717, 435 N. Michigan Ave., Chicago, IL 60611, (312) 644-0828.

Bustling exhibit floor at PLCAA convention.

ENERGY

Peat may be Canadian energy alternative

The construction of a peat-fired steam-electric generating station in northeastern New Brunswick would be technically and economically feasible, according to a preliminary study prepared for the Canadian Government by Montreal Engineering Company Limited.

The study indicates that, as in Ireland and Finland, peat could be an economical alternative to oil in Canada and could create a significant number of permanent jobs. The preliminary findings will be evaluated by the federal and provincial governments and the New Brunswick Electric Power Commission to determine whether there is a basis for proceeding with pre-engineering and detailed design studies.

SALES

Greater demand for horticultural service

Horticultural services are on the increase, according to statistics released

Continues on page 12

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The Runabout is a labor-saver from the word "go." Its wheel-type steering and tight 17′ turning circle make the Runabout maneuverable and easy to handle. Special tires make it easy on turf, too—even under full load. And its 3-speed synchromesh (second and high) transmission and heavy-duty tubular steel frame make the Runabout about as reliable a turf vehicle as you can find.

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For even greater savings, the fuel-stingy 12-hp Runabout lets an operator handle 1,000 pounds of cargo with responsive handlebar steering. And, like its big brother, this Runabout runs on regular gas, and is backed up by Cushman's worldwide dealer network.

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LANDSCAPE CONTRACTOR NEWS

Expanding frontiers earmark ASLA meeting

Speakers at the American Society of Landscape Architect's annual meeting in Denver stressed the awareness and involvement of the industry in a wide diversity of work.

"The scope has arrived that we are involved in every facet of life," says Bill Oyler, director of programs and administration for ASLA. The November meeting forwarded that theme to more than 1,600 attendees.

Keynote speaker John Naisbitt—publisher, author, futurist, and newspaper columnist—spoke at the opening session about the change to which landscape architects will be expected to respond in the 1980's. The 22 individual educational sessions that followed emphasized this in specific ways. The programs were divided into five major education topics—energy, economics, communications, creative management, and design quality and values—and each of these were divided into five or six sessions.

Booth space was filled and included companies selling computers, lighting, irrigation equipment, turf, indoor-outdoor furniture, bridges, recreation equipment, and management consulting services. Oyler expects that the meeting next year in Washington, DC, will contain 100 booths, a good percentage more than this year's 67.

California show will cover entire field

The California Landscape Contractors Association's 1981 Landscape Industry show, scheduled for March 26-27 at the Long Beach Convention Center, promises to be a complete show for the landscape industry.

The planning committee is hoping to gather people and products from every aspect of the industry, including the related services and products used in the offices of landscape contractors as well as those used in the field. The organizers are urging suppliers of stationery, office furniture and equipment, computer and communication systems, public relations people, and financial consultants to exhibit.

This marks the second such show sponsored by CLCA. For further information about it, contact David Concannon, 1419 21st St., Sacramento, CA 95814, 916/448-2522.

Irrigation Association plans full course

The Irrigation Association will hold its first two-week Landscape Irrigation Institute in cooperation with the University of California at Riverside, March 23-April 3.

The intensive two-week course, designed for personnel of manufacturing, distributing, contracting, and consulting firms, will comprise 11 days of instruction and field trips.

Topics of instruction include basic principles of soil and water; principles of turfgrass, adaptation, growth, and maintenance; irrigation components and types; hydraulic principles; and installation, management, and scheduling of irrigation systems. Field trips will go to an irrigation pipe manufacturer, sprinkler manufacturers, irrigation systems, and laboratories.

Registration information is available from: The Irrigation Association, 13975 Connecticut Avenue, Silver Spring, MD 20906, 301/871-1200.

by the Agricultural Services Census for 1978.

The census indicated $2.6 billion gross receipts for that year, nearly double the amount reported in 1974, although part of this increase may be due to more complete reporting. More than 36,000 landscape planting and maintenance service firms who derive their major source of income from garden services had gross receipts of $1.4 billion; over 19,500 arboricultural firms showed gross receipts of $1.06 billion; and 5,228 landscape planning and counseling services reported $.18 billion in gross receipts.

Since more limitations are being placed on the pesticides that homeowners may use, professional landscape and horticultural services are expected to be in greater demand in the future.

FERTILIZER

Fertilizer movement advances in October

Domestic market movement for fertilizers from producers increased 3% in October above the same month in 1979, even though total month-end inventories also reached higher levels, according to a report by The Fertilizer Institute.

Domestic disappearance for October of both nitrogen and potash products was well ahead of the same month last year, while exports of all finished phosphate products also advanced.

"The October report clearly shows the rapid pickup in mid-fall movement that had been expected," noted Institute President Edwin M. Wheeler. "Recent industry reports from the field indicate that this improvement has continued into November for most products."

EROSION CONTROL

Scientists study reasons for erosion

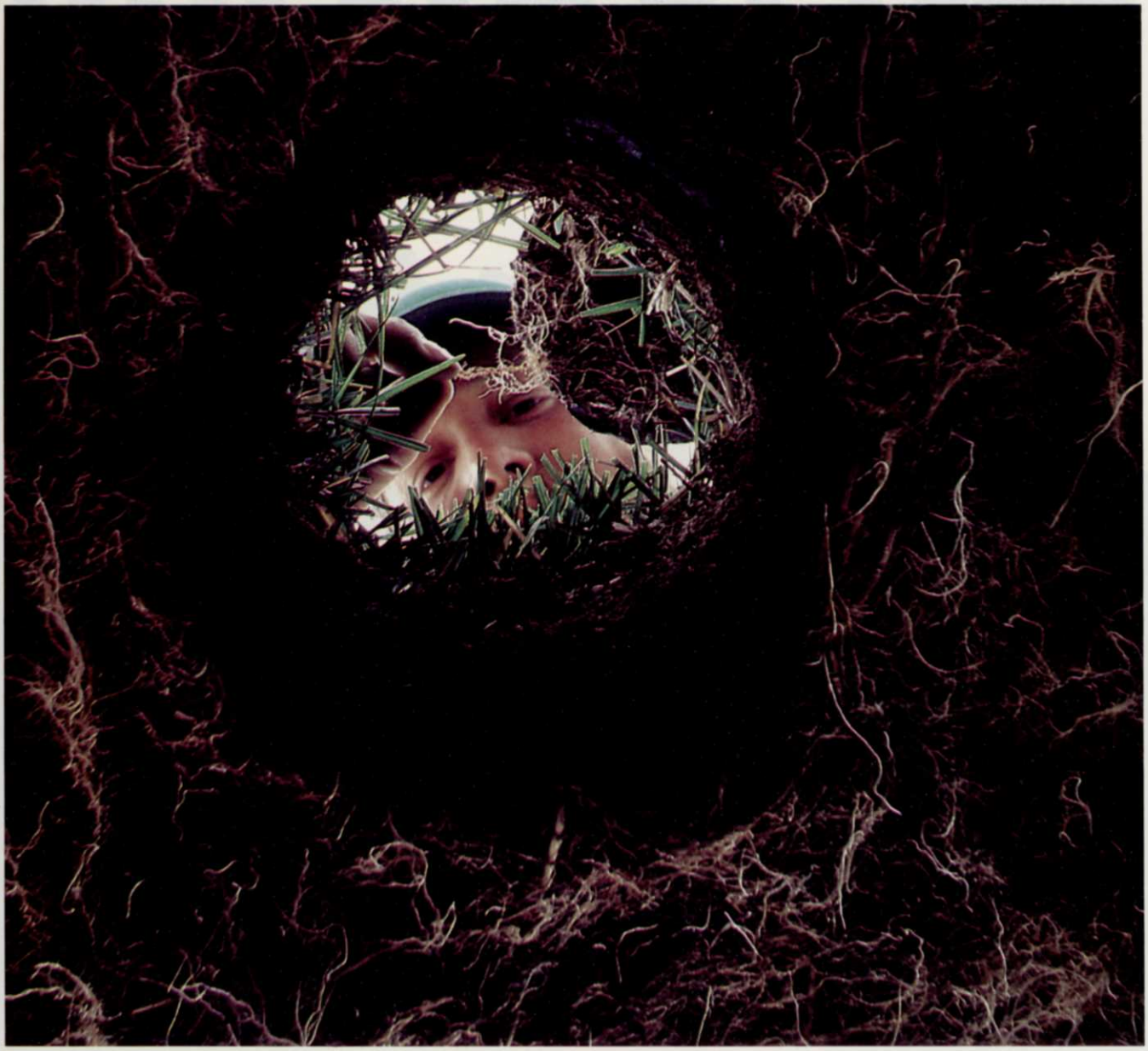
In the Pacific Northwest, flooding and erosion are most likely to be caused by rainfall on top of frozen soil.

Myron Molnau and D. K. McCool, researchers at the Idaho Water Energy Resources Research Institute of the University of Idaho, are studying erosion to determine the extent to which it occurs on frozen soils. They plan to evaluate the effect of various land use practices, such as tillage, on the severity of runoff from frozen soils.

Their preliminary data suggests that minimum tillage controls erosion best.

Continues on page 16

GRASS ROOTS CANDIDATE!



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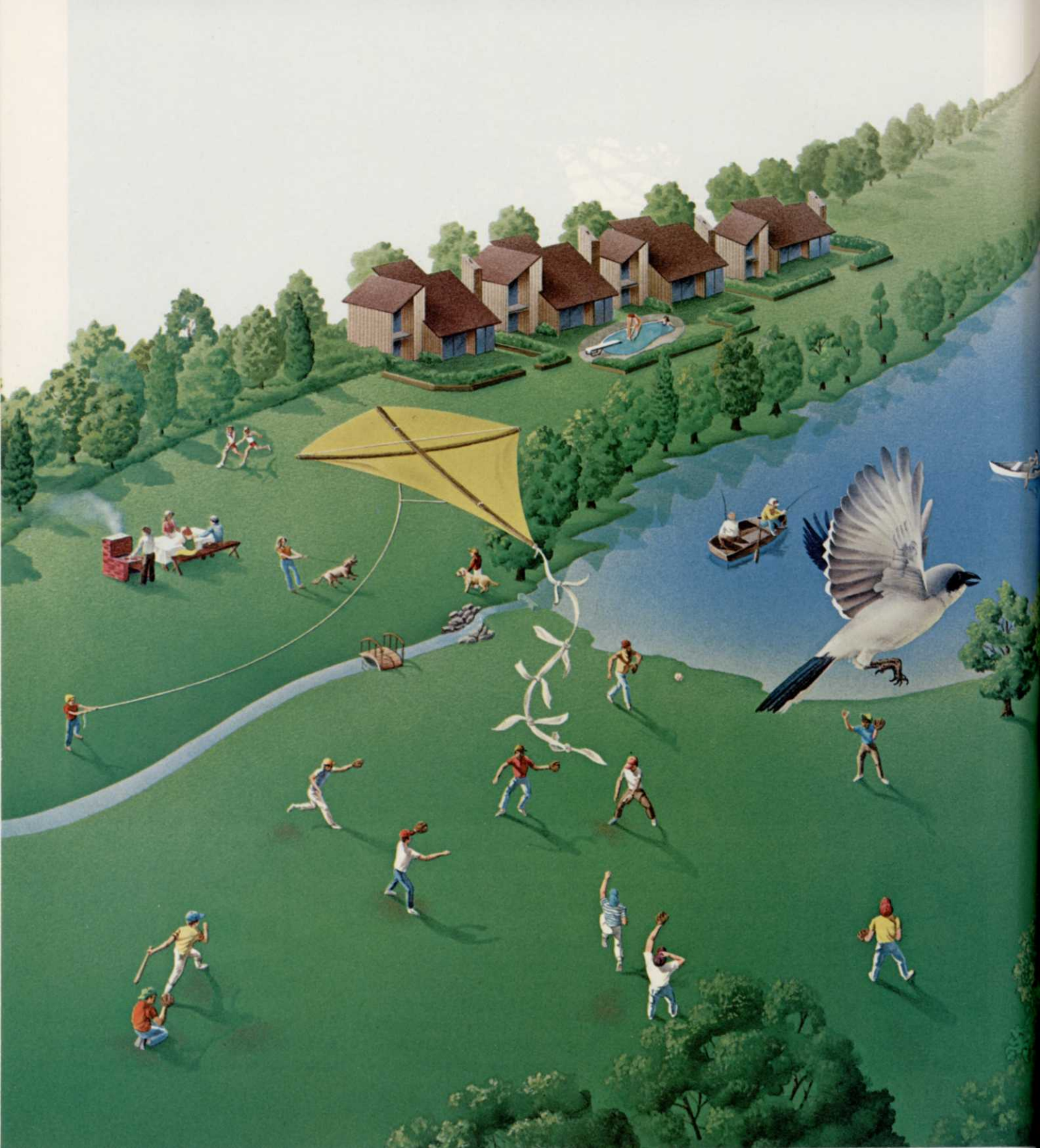

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GOVERNMENT UPDATE

EPA says no RPAR against chlordane

The Environmental Protection Agency's Office of Pesticide Programs has recommended there be no RPAR against chlordane, says an officer for Velsicol Chemical Corp., a manufacturer of the substance.

Charles Frommer, director of regulatory affairs for Velsicol, says, "Instead, EPA plans a comprehensive review of all compounds with termite labels. Some 30 active ingredients are involved."

Speculation over the status of chlordane spread last summer when the General Accounting Office sent a letter to EPA Adminstrator Douglas M. Costle, calling for a formal RPAR of the pesticide. GAO cites information from the Defense Department that showed high concentrations of chlordane in some homes where heating ducts became contaminated. They contend that there may be millions of homes in the U.S. affected in this manner.

Velsicol contends that such air plenum contamination is the result of misapplication and that no health hazard exists when proper application procedures are followed.

OSHA Book tells full story of agency

All About OSHA, 1980 edition, contains much information about the agency and is available for no cost. To obtain a free copy, write: OSHA Publications Office, Rm. S-1212, Department of Labor, 200 Constitution Ave., N.W., Washington, DC 20210.

Government agencies find dioxins in 2,4-D

The Environmental Protection Agency and Agriculture Canada have found dioxins in 2,4-D samples, but have taken no regulatory action. EPA and Agricultural Canada officials said that decisions on regulatory action, if any, would be made before the next 2,4-D season, March in the U.S. and June in Canada.

EPA's response to the findings was to prepare a request to all 2,4-D manufacturers for technical samples of the pesticide used in the U.S. and descriptions of 2,4-D manufacturing processes. Some EPA officials suspect the dioxin contamination might be keyed to a particular manufacturing process. Dow Chemical, Diamond Shamrock, and PBI Gordon have already submitted samples.

Agriculture Canada emphasized that it had not found the "most acutely toxic member of the dioxin family, the 2,3,7,8-TCDD isomer" in 2,4-D samples tested.

Social Security, minimum wage increases

On January 1, the tax base for Social Security rose to $29,700 and the rate to 6.65% This means an employee earning $29,700 will pay $1,975.05 in Social Security taxes, and the same amount will be paid by his employer. Also, the minimum wage has increased to $3.35 an hour.

National Arboretum begins bonsai holding

The chief of the U.S. Department of Agriculture's Forest Service, R. Max Peterson, presented the National Arboretum with the first tree to be included in a new American bonsai collection.

The presentation was part of a series of national activities held last year to commemorate the 75th anniversary of the Forest Service.

Ralph J. McCracken, USDA associate director of Science and Education, accepted the bonsai on behalf of the National Arboretum's managers—USDA's Science and Education Administration.

The tree, a naturally dwarfed Ponderosa pine about 150 years old, was found growing on the Gifford Pinchot National Forest in Washington.

"Freeze cycles in the Pacific Northwest, especially, have a lot to do with erosion," says Molnau. "They first break down soil clods, creating a smooth surface for the water to run over." He explains that after a rain and freeze-thaw cycle, water collects on top of the rough frozen surface rather than infiltrating the soil. Since it is warmer than the underlying soil, it slowly breaks down frozen clods and forms a thin layer of mud on the surface. Then, if there is a large amount of precipitation, the thin layer of sediment is washed off and erosion occurs.

EQUIPMENT

Tiller shipments up; mowers show decline

Rotary tiller shipments by domestic manufacturers rose 9.8% during the year ended August 31, 1980, while factory shipments of walk-behind and riding mowers, lawn tractors, and riding garden tractors declined for the first time in four years, according to recent estimates of the Outdoor Power Equipment Institute.

In 1980, 621,000 tillers were shipped, compared with 565,400 in the previous year. Factory value increased from $123.3 million to $148.4 million, or 20.4%.

Shipments of riding garden tractors declined 16.9% to 196,000 units with an F.O.B. factory value of $312.5 million. Last year's 236,000 units were valued at $339.3 million.

Estimated shipments of lawn tractors/riding mowers totaled 721,000 for 1980, down 9.6%. F.O.B. factory value increased 3.2% from $458.5 million to $473.3 million.

Walk-behind power mower shipments fell 3.5% to 5.7 million units, a decline of 200,000 units from the 5.9 million shipped in 1979, while factory value increased 7%, from $656 million to $701 million.

AWARDS

AAN governors present Green Survival Awards

The Governor's Green Survival Award, established by the American Association of Nurserymen for a superb contribution to environmental improvement through the use of living plants, was presented in recognition of two outstanding outdoor plantings in the States of Michigan and Illinois.

John Light, II, governor of the Michigan chapter of the AAN, presented one award to the City of Marshall for its

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ENERGY SAVING CONCEPTS APPLICABLE TO LANDSCAPES

Copyright by Anne Simon Moffat, horticultural journalist, and Marc Schiler, professor of architecture, Cornell University, Ithaca, NY. To be published in book form by William Morow & Co., 1905 Madison Ave., New York NY 10016, in March 1981.

The goal of all contemporary building design, whether it falls under the heading of architecture, landscape planning, or interior decoration, is to increase human comfort and reduce energy needs for space heating and cooling. The physical strength and mental activity of all people are improved within a specific range of climatic conditions. Outside this comfort zone, efficiency plummets; discomfort, stress, and the threat of disease increase.

There is a slight variation in the perception of comfort, either because of inherited or cultural characteristics. Most women choose a temperature a few degrees warmer than do men, young people prefer a temperature a few degrees cooler than do the elderly, and Eskimos thrive in a cooler climate than do Africans. But there are accepted, worldwide standards for human comfort.

This article analyzes the sensation of comfort and describes how the great climatic forces—sun, wind, and precipitation—affect it. It also demonstrates how plants may enhance comfort while reducing energy consumption.

The four factors that affect human comfort are: the energy contained in objects that radiate heat, the temperature of air, its movement, and humidity. Precise definitions of each are needed to understand how they influence comfort.

Heat, which is a form of energy, is distinguished from temperature, which is a measure of how much energy is stored. For example, two freshly poured cups of tea, one half-full and the other filled to the brim, are the same temperature. But the full one contains more heat energy. Different materials require different amounts of energy to be raised to the same temperature. "Specific heat" refers to the energy needed to raise a given volume of a substance by one degree Fahrenheit. The higher a material's specific heat, the more heat it holds, and the longer it takes to cool down. For example, air has an extremely low specific heat and heats up rapidly; metals such as gold and lead have higher specific heats. Water has a very high specific heat; it takes a lot of energy to reach a certain temperature, acts as an excellent reservoir of heat, and releases a lot of heat when cooling down. This is why large bodies of water such as lakes and oceans have a pronounced effect on climate. They heat up and cool down slowly, and moderate extremes of temperature.

Heat energy itself can be transferred by four methods: radiation, conduction, convection, and changes of state. Heat always travels from warmer to cooler substances, attempting to remove temperature differences.

Radiation transfers heat in space from object to object. It requires no contact between the object emanating the heat and the receiving substance and may take place in a complete vacuum. Radiation is responsible for the heat you feel when you stand in front of a fireplace or lie on a beach and soak up the sun's energy. Radiant heat can be collected from the sun independent of the air temperature. A sun-filled room collects radiant heat and warmth through a window, even in midwinter. Conversely, at night heat energy that has been absorbed during the day will be reradiated back into the sky and lost, if it is not blocked. In arid regions that have cloudless nights there is the potential for enormous radiational cooling at night. In cities, however, the low overhead smog often prevents nighttime radiational cooling. Radiation can be blocked by opaque barriers such as walls, heavy drapes, or plants with dense foliage; it can be filtered by translucent objects such as clouds, light shades, or vines on trellises.

In contrast, conduction transfers heat by direct contact. It is responsible for the heat you feel when you touch a hot iron or press a hot-water bottle to an aching part of your body. Conduction of heat away from the body produces the shivering sensation following a plunge into a cool swimming pool. Blocking conduction is more difficult than blocking radiation and requires specialized insulating materials with air cells that inhibit heat transfer such as wood, wool, polystyrene foam, rock wool, or thermopane windows.

Convection is similar to conduction, but it conveys heat in movable, fluid media, including air and water. It is a form of mixing and occurs simply because most materials expand and rise when heated. For example, warmed air rises, which is why smoke from fires drifts skyward. If you stand over a gravity-feed hot-air grate, the warm air currents transfer heat to your feet via convection. This mode of heat transfer can be blocked by physical barriers that inhibit the movement of air and other fluids.

Finally, heat can be transferred through a change of state, also called latent heat. It refers to the amount of heat taken up when a substance melts from a solid to a liquid or evaporates from a liquid to a gas. Changes of state consume vast quantities of energy. For example, it takes 180 British thermal units of heat energy to heat one pound of water from freezing to boiling.* One thousand additional Btus are required to evaporate the same pound of water into steam, without increasing the temperature of the steam at all. The enormous capacity of water for latent heat explains why a filled teapot cooing over a redhot burner doesn't explode. The energy of the flame is used to convert water into steam. This principle also explains an important aspect of the human body's system for temperature regulation. The body releases excess heat by sweating, and the evaporation of this fluid uses up and draws away from the body large amounts of heat energy. Latent heat is also responsible for the air-conditioning influence of plants. Plants evaporate huge amounts of water, drawing heat from the air in the process and storing it as latent heat in gaseous, water vapor. This process lowers the ambient air temperature and increases humidity. In one sunny, summer day an acre of turf can transfer more than 47,000,000 Btus of energy, enough to evapo-

*The definition of a British thermal unit is the amount of heat energy needed to heat one pound of water one degree Fahrenheit. Therefore, it takes (212-32) or 180 Btus to heat a pound of water from freezing (32°F) to boiling (212°F).

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rate about 6,800 gallons of water. One square meter of grass can return half a ton of water to the atmosphere in the course of a growing season, transferring tremendous amounts of energy. Temperatures over grassy surfaces are about 10 to 14 degrees Fahrenheit cooler than temperatures over exposed soil because grass evaporates water and transfers heat energy of the air into the latent heat of water vapor. Obviously, plants must draw upon vast supplies of water to produce this dramatic cooling effect.

If you have a good understanding of heat, temperature, and heat transfer, the other factors contributing to comfort—humidity and air movement—are easier to understand.

Relative humidity is the ratio of the actual amount of moisture in the air compared to the maximum amount it could hold at a given temperature. As humidity increases it approaches the saturation point, the point at which it can hold no more moisture, and precipitation as snow or rain occurs.

With increasing humidity, it becomes harder to add more water to the air. It is more difficult to evaporate sweat in humid environments because the air is already approaching its saturation point. That is why you feel more uncomfortable in humid environments; it is more difficult to unload excess body heat by sweating and evaporation. When a relative humidity of 60 percent or more accompanies a temperature of more than 80°F., it feels uncomfortable, muggy, and humid. In an arid, desert climate, the same temperature would not be uncomfortable because body heat could be easily transferred into the air by sweating and evaporation. On the other hand, high humidity at low temperatures accentuates the impact of cold because it speeds heat loss and gives an unpleasant, raw feeling. When the air temperature is much lower than body temperature, conduction takes over. The air's specific heat is higher when moist, and it rapidly draws heat away from the body.

Air movements also contribute significantly to comfort and are measured by recording their velocity and direction. They have their greatest impact on comfort by increasing heat transfer. In hot, humid climates air movements are desirable because they increase evaporation and heat loss, but in hot, arid climates winds may be undesirable because they carry away precious water. Air movements in cold weather are undesirable and even dangerous because they carry away heat. The notorious "wind-chill" factor describes the accelerating impact of air movement on heat loss. For example, at zero degrees a casual well-clothed hiker need not worry about frostbite if the air is still. But at 20°, if a gusty 40-mile-per-hour wind is blowing, cautions should be taken to guard against excessive heat loss from the body's extremities, which may lead to frostbite.

However, the ability of humans to adapt their physiology to extremes of climate is limited. Our ability to survive depends on our aptitude for analyzing climates, and then manipulating our environment and building shelters that adapt to the available conditions. The following sections analyze the forces sun and wind —and indicate how our homes and offices can be designed to minimize the impact of adverse weather. We emphasize the value of using the landscape to temper extremes of climate and to promote human comfort.

The Sun

The sun commands the daily genesis of weather and is the greatest single force affecting climate. Its radiant energy drives the machinery of climate all over the world. Annually, the earth makes a 600-million-mile orbit around the sun in an elliptical path and, at the same time, rotates on its own axis from west to east, making the sun appear to move from east to west. Knowledge of these two types of motion enables us to predict the sun's "position" in the earth's celestial dome. This permits some manipulation of the environment to utilize the sun's energy to best advantage. During warmer periods, the goal is to block the sun's radiant energy from entering living areas. But at other times, all available radiation should come into the home.

Acquiring an understanding of the sun's path, the arc it travels in the sky, is the first step to planning energy-efficient design. The solar path has two components: its absolute height in the sky, measured by the altitude angle; and the distance it travels on its path between the eastern sunrise and the western sunset, called the bearing angle. All positions in the solar hemisphere can be described by these two measurements. The bearing angle is defined in reference to due north because most people learn to read maps from this perspective. (However, in some disciplines, including architecture and some branches of engineering, it is customary to measure bearing angles from due south.)

You will notice that the seasonal changes in the sun's arc are most striking as you travel away from the equator. As you travel north, the period of daylength increases dramatically in the summer, until you reach the extreme of midnight sun in the arctic. In northern regions in the summertime, the sun rises farther to the northeast and sets farther to the northwest. In the winter the sun's shorter path originates farther southeast and sets farther southwest and barely rises over the horizon.

But in the extreme north, no matter the length of the sun's arc, it never climbs very high into the sky. One must travel south, toward the equator and into the tropics, to witness the sun directly overhead.

The ability of the sun to add radiant heat to a building depends both on its position in the sky and on the intensity of sunlight. The intensity of radiant energy reaching the earth depends on a number of variables, including the presence of clouds, smog, and, most importantly, the density and thickness of the atmosphere. During winter the sun is lower in the sky than it is during the summer, and radiant heat must pass through a larger slice of the atmosphere to reach the earth than it does during summer. The longer trip through the atmosphere diminishes the sun's intensity. That is why the winter sun is generally weaker than the summer sun. However, if we use proper building design the winter sun can still contribute valuable radiant energy, despite its diminished intensity.

As light and heat in the form of solar radiation

penetrate the atmosphere to the earth, a variety of things may occur. A fraction is reflected back into space from high clouds; part is scattered into the sky vault as it strikes small particles in the atmosphere; and part is absorbed and reradiated by the gases in the atmosphere. The remaining radiation penetrates to the earth's surface where it is either absorbed or reflected by the ground, buildings, plants, and animals. Absorbed radiation heats the objects, which can then reradiate the heat. Reflected radiation is not absorbed and is bounced back into the immediate atmosphere. In nature, most surfaces absorb some radiation and reflect another portion.

Control of Radiation by Plants

Control of both absorbed and reflected radiation is necessary to maintain human comfort, and this can be achieved by complete obstruction or filtration of direct radiation, or by the reduction of reflected radiation. Trees, shrubs, grasses, and other ground covers are among the best materials for the control of solar radiation.

They offer climate control in tropical regions, where solar radiation is almost always oppressive, and in temperate regions, where solar radiation requires only seasonal control. Plants interact with solar radiation to influence microclimates in two ways. First, plants absorb solar radiation and cast shade. Second, most of this captured, radiant energy is used to transpire and evaporate water from plants. This converts most of the captured sunlight into latent heat, and relative humidity is increased instead of air temperature. The remaining captured radiation is used in photosynthesis. In particularly dry air, plants may actually lower ambient air temperature if they have sufficient water to transpire.

Selected plants can almost completely block the sun's rays. Species such as Norway maple *(Acer platanoides)*, red ash *(Fraxinus pennsylvanica)* and the small-leafed European linden *(Tilia cordata)*, which have dense foliage, multiple leaf layers, or a dense canopy, can absorb and block at least 95 percent of the sun's energy in the visual spectrum and 75 percent across all radiation spectrum combined. A more modest filtration of solar energy occurs when plants with open, loose foliage, including vines and trees such as honey locust *(Gleditsia triacanthos)* and pin oak *(Quercus palustris)* are used. One advantage of vines is that they offer shade almost immediately after planting while trees take longer to mature.

In temperate climates deciduous plants in full leaf are generally the best interceptors of direct solar radiation. They offer their strongest sun-blocking potential in summer, and in winter, when their leaves have been shed, they permit desirable sunshine to penetrate. The dynamics of seasonal foliage variation provide natural sun control. When evaluating plants as sun filters the species' shape must be considered along with its density. Each plant casts a distinctive shadow, which may be round, oval, pyramidal, or columnar in form. Consider the form of the area to be protected before selecting plants to cast shade.

Reflected radiation from the sun is best controlled by plants with coarse surfaces. The multi-faceted surfaces of leaves are much better at reducing reflection than the light, smooth surfaces of man-made pavements or architectural materials. Dark plants with smaller leaf surfaces such as conifers (*Pinus* species, for example), or plants with pubescent, fuzzy surfaces, such as elm (*Ulmus* species), greatly reduce reflection. Vines growing up walls or trellises and ground covers such as grass, pachysandra, or ice plant *(Mesembryanthemum)* also buffer against unwanted reflection.

By blocking or filtering direct or reflected sunlight, plants can temper local climates in a powerful fashion. In the daytime, the ground temperature in a forest may be as much as 25°F. cooler than the top of the tree canopy. At night the foliage mass prevents reradiation into the sky, and the temperature at the forest floor will be warmer than the temperature at the canopy. At midday, a vine-covered wall is always cooler than a bare wall. Dramatic proof of how plants relieve the sun's impact by casting shade was gathered by researchers in California's Imperial Valley, who found that bare-surface ground temperatures ranging from 136° to 152°F. cooled an average of 36°F. in only five minutes after the arrival of the shadow line from overhead foliage.

Wind

The sun provides the energy that drives atmospheric motion or winds. They start blowing when warm air, expanding, rises and cooled air, contracting, sinks. From this simple beginning the behavior of winds grows almost inconceivably complex. Air movements, if at low velocity, are usually pleasant and desirable. However, when the velocity increases, they are capable of causing great discomfort and destruction to life and property.

Winds are grouped into three categories: local and regional persistent winds; global persistent winds such as the trade winds of the tropics; and maverick winds such as cyclones, tornadoes, and hurricanes. Local persistent winds are almost invariably small-scale convection winds—the sea breeze, the land breeze, the mountain wind, and the valley wind. They are of great importance in influencing human comfort, and they can be controlled with careful landscape design.

Air flows in much the same way as water. Cold air settles to the lowest level and hot air rises. It will flow over, under, and around anything that is sturdily engineered, and will be bent, bounced, and resisted by obstructions such as buildings, fences, hills, valleys and other earth forms, and plants. Air movements, again like water, exert pressure against any surface that inhibits their flow. Whenever the wind flows over a solid barrier there is increased pressure upwind (where the wind blows from) and a protected, low pressure area immediately downwind or leeward (where the wind blows to). However, the low pressure area pulls the boundary layer of air flowing over the barrier into it. Thus, the lee side of a slope receives protection and contains a pocket of relatively still, quiet air. But this protected region has a limited range because the low pressure region sucks wind back into place.

In contrast, a pierced barrier allows some wind to penetrate through it and creates less pressure differential between the upwind and the downwind. This penetrable windbreak has less wind reduction

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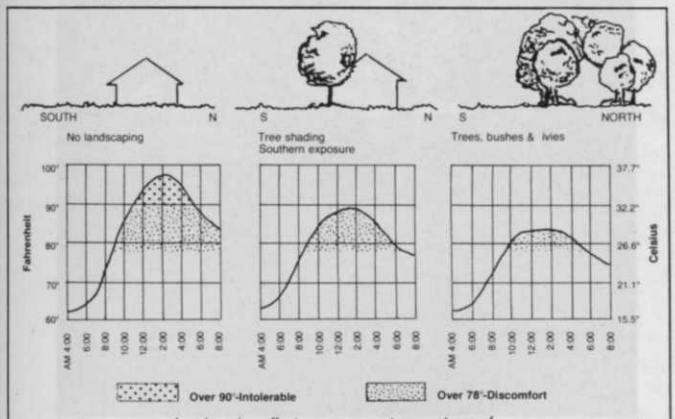
near it, but the overall calming effect extends farther beyond it. The suction immediately behind this penetrable windbreak is less than that produced by a solid barrier, and the acceleration of wind back to its original speed is more gradual.

A windbreak of trees acts as such a penetrable barrier. These windbreaks are most effective when placed perpendicular to the prevailing wind.

Wind Control by Plants

As we have seen, heat loss from a building's surface is proportional to the square of the wind velocity (that is, the speed of wind multiplied by itself). Wind increases heat loss by convection and by adding to the volume of cool air blown into a building, which subsequently may need to be heated. Therefore, a carefully situated windbreak of trees and shrubs can be a powerful energy saver in climates with periods of cool weather.



Landscaping effects on summer temperatures of a house in a temperate climate

Because the quality of wind protection depends on the penetrability, height, and width of the plants used, recommendations for certain species as windbreaks are difficult to make. The more penetrable the windbreak, the more modest wind reflection to leeward, but the farther behind the windbreak this modest protection extends. Dense, coniferous evergreens that branch to the ground provide the most effective year-round plants for wind control, and deciduous trees and shrubs in full leaf are effective in summer.

In general, wind speed is reduced for a distance of two to five times the height of the barrier upwind of an obstruction, and up to fifteen times the height downwind. The maximum shelter from wind is obtained from three to five times the height of the barrier (downwind). Wind velocity is cut up to 80 percent directly downwind of a dense screen planting such as spruce (*Picea* species) trees. For example, a windbreak of two-foot Austrian pine *(Pinus nigra Laricio)* cuts a 12-mile-per-hour wind velocity to 3 miles per hour. A loose barrier of Lombardy poplar trees (*Populus nigra* cv. 'Italica') in full foliage reduces leeward wind velocity by only 40 percent. In general, a leafless deciduous tree has only 60 percent of the wind-blocking ability of its full, "leafed" potential. Irregular windbreaks that have some foliage density throughout their height are most effective at breaking up the airstream over it. Therefore, a mixture of species and sizes of plants makes a better wind control.

The lower wind velocities on both sides of windbreaks encourage precipitation to fall out of the air. This means that small snowdrifts and large snowdrifts may be formed downwind of a windbreak. The rules that explain how plant barriers influence air movements also explain how such barriers affect snowdrifts. The downwind drifts near a solid barrier are deep and do not extent a great distance from the barrier. In contrast, the downwind drifts near a penetrable windbreak are shallow, extending to a greater distance from the barrier. Solid barriers produce drifts on both sides, and more open plantings keep the drift to the downwind side. The greater the velocity of the wind, the closer the drift to the barrier itself. A well-designed windbreak will slow the velocity of the wind and cause snow to be deposited before it reaches a path or driveway. In snowy climates, windbreaks should not be put immediately upwind of driveways or walkways, but rather a considerable distance upwind.

Plants that provide protection from wind to leeward may also produce a pocket of cold beneath them. Plant designs that group trees for wind control and permit the accumulation of snow and undisturbed litter beneath them insulate the ground. This means the ground warms slowly on a sunny day. This ensures that snow thaws later and more evenly in the spring. Spring perennials, including forsythia and early flowering bulbs, planted beneath such windbreaks will be well insulated against wind and subzero temperatures, but will bloom later in the spring.

It is also important to recognize that at a break in a wind barrier high pressure is released and the wind velocity increases above its open field velocity. This is known as the Venturi effect. For example, just past the edge of a moderately dense shelterbelt, wind speed is increased 10 percent above open field velocity. Also, because the foliage mass of a tree serves as a direct block to the passage of air, air movements directly beneath the leaf canopy may be accelerated. Therefore, careful placement of a windbreak is essential, and poorly placed windbreaks should be removed. Their growth should be carefully monitored to prevent the development of scrawny bare spots near the ground that encourage the acceleration of wind. If trees with high canopies are desired for a windbreak, fill in the bare spots beneath them with shrubs and bushes.

The Venturi effect may also be used to blow areas clear of snow and to provide snow-free parking areas, walkways, or roadways. Alternatively, plantings may be designed to channel winds and cause desirable snowdrifts and deposits on ski trails and toboggan runs.

Plants that block wind may also prevent heat loss by adding a layer of insulating air around a building. A hedge of yew (*Taxus* species) or privet *(Ligustrum vulgare)* adjacent to a wall will provide a pocket of dead-air space, insulating against heat loss.

In addition to obstructing, filtering, and deflecting winds, plant barriers may channel and accelerate beneficial breezes into defined areas. This strategy is desirable in warm climates when cooling breezes are needed. A funnel of trees or tall hedges that guides the prevailing winds can provide constant, natural "air

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DECIDUOUS TREES MODIFY TEMPERATURE OF BUILDINGS

By Robert L. Ticknor, Professor of Horticulture, North Willamette Experiment Station, Oregon State University, Aurora, OR

The following three papers were presented and discussed at the 1980 Ornamentals Northwest Seminars, August 24-26, in Seattle, WA.

It has been estimated that 32 percent of the energy used in the United States is for heating and cooling buildings occupied by people. One way of reducing this energy use is by climate modification through planting suitable trees around homes and other small structures.

Fuel Consumption

Fuel consumption is only half as much in a 3 mph wind at 32°F as with a 12 mph wind at 32°F. While a reduction of this magnitude is not possible with a limited wind break, a reduction of 40 percent in fuel consumption has been reported when shelter belts were planted on three sides of a dwelling. The effect extends for 20 times the height of the windbreak so in urban situations street trees and other landscape trees must contribute to fuel savings by reducing wind velocity. Temperatures downwind of a shelterbelt 3 to 4°F higher than upwind were found in Illinois which could be another of the factors contributing to reduced fuel consumption in winter.

Trees and Cooler Temperatures

Lower temperatures under and around trees during the summer is a widely observed phenomenon. Temperatures 10 to 20°F lower in the shade of a tree set up convection currents increasing the feeling of comfort in the shade. House trailers in an Alabama study were 104°F inside in full sun but only 80°F in the shade of trees.

This cooling effect is achieved two ways. Solar radiation is intercepted so less heating of interiors of houses, roofs, and the surrounding pavement takes place, reducing the need for fans or air conditioning to maintain comfort. The evaporative cooling effect of a fairly large tree transpiring 75 to 100 gallons of water a day is equivalent to five average sized air conditioners operating 20 hours per day.

Tree Placement

Trees on the east and west sides of a building can intercept the low angle rays of the sun which strike the windows at near a right angle at the beginning and end of the day causing maximum heat build-up within the building. They also reduce heat accumulation in the attic area by intercepting part of the solar radiation that strikes the roof.

A wide roof overhang prevents the summer sun ray from contacting the windows of a building from the south but does not prevent heat build-up in the attic area. This heat build-up in the attic radiates heat into the building below for hours after the sun goes down. Heat build-up can be prevented by planting deciduous trees on the south side of the house as well as the east and west sides. If solar collectors for water heating are planned, then trees should not be planted on the south side.

These two trees, Acer rubrum 'Red Sunset' (left) and Acer rubrum 'October Glory' show the difference in time of defoliation, the critical factor for a shade tree.

Foliation Season

Deciduous trees with a relatively short season in foliage are desirable in the cool cloudy western part of the Pacific Northwest where the period of bright sunshine and high temperature is short. East of the Cascades the sun is bright all summer so trees with a longer period in leaf are desirable.

Observations made in the Landscape Tree Trial at the North Willamette Experiment Station have indicated the period of foliation for over 150 species and cultivars. Trees that start to leaf out between February 26 and March 31, are considered early, while trees starting to leaf out after May 15 are classed as late. Table I shows the early and Table II shows the late foliating trees. The time of defoliation is the other factor that determines the length of the foliation season. Trees that are 100 percent defoliated before November 5, are considered early defoliators and are listed in Table III while those that defoliate after December 5, are considered late defoliators and are shown in Table IV. There is variation in the dates of these events from year to year but trees that generally fall within these dates are not listed. Of course a larger number of trees react

between the extreme dates and are not listed in this report.

The average height and width in feet at planting after 5 and 10 years of most of the trees mentioned is shown in Table I. The trees were grown in a fertile, well drained soil without competition and received summer irrigation so the sizes may be larger than similar aged trees growing under less favorable conditions.

If we wish to shade a building, medium or large trees are needed but smaller trees can be helpful for blocking sunlight from a limited area like a window or patio. The trees in the tables are listed alphabetically regardless of size.

Trees that both come into leaf late (late foliators) and drop their leaves early (early defoliators) have a relatively short period during which they retain their leaf canopy: they are foliated to provide shade during the warmest summer months; it is important that a tree defoliate early in the fall so benefit can be derived from direct solar radiation striking the building or object previously shaded. The number of trees that come into leaf late, then drop their leaves early is limited to *Acer saccharum* 'Green Mountain' ('Green Mountain' Sugar Maple), *Tilia cordata* (Little Leaf Linden and the cultivars 'Greenspire'). Very close to this ideal are *Gleditsia triacanthos inermis* (Thornless Honey-locust) and several of its cultivars such as 'Rubylace,' 'Shademaster,' 'Skyline,' and 'Sunburst.'

The list of desirable trees is expanded considerably if trees which defoliate early are used regardless of their season of foliation. Late defoliating trees in Table IV are particularly undesirable for climate control since the temperatures are cooler and the sunlight is less in November and December than in April and

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Table I

EARLY FOLIATION* TREES WHICH START TO LEAF OUT BETWEEN FEBRUARY 26 AND MARCH 31 IN THE LANDSCAPE TREE TRIALS AT THE NORTH WILLAMETTE EXPERIMENT STATION, AURORA, OREGON

Scientific Name	Common Name
Acer bueroerianum	Trident Maple
Acer ginnala	Amur Maple
Acer neguno	Box Elder
Acer rufinerve	Redvein Maple
Betula papyrifera occidentalis	Western Paper Birch
Betula platyphylla japonica	Japanese White Birch
Carpinus betulus fastigiata	Upright European Hornbeam
Cercidophyllum japonicum	Katsuratree
Cornus florida welchi	Welch Flowering Dogwood
Cornus nuttalli 'Goldspot'	Goldspot Pacific Dogwood
Corylus colurna	Turkish Hazel
Crataegus 'Autumn Glory'	Autumn Glory Hawthorn
Crataegus laevigata 'Crimson Cloud'	Crimson Cloud Hawthorn
Crataegus laevigata 'Paul's Scarlet'	Paul's Scarlet Hawthorn
Crataegus laevigata 'Winter King'	Winter King Hawthorn
Evodia danielli	Korean Evodia
Evodia henryi	Henry Evodia
Evodia hypehensis	Hupeh Evodia
Halesia monticola	Mountain Silverbell
Koelreutaria paniculata	Golden Raintree
Liquidambar orientalis	Oriental Sweetgum
Liriodendron tulipifera	Tulip Tree
Malus floribunda	Japanese Flowering Crabapple
Parrotia persica	Persian Parrotia
Phellodendron amurense	Amur Corktree
Prunus cerasifera 'Thundercloud'	Thundercloud Purple-Leaf Plum
Prunus sargenti columnaris	Columnar Sargent Cherry
Pterostyrax corymbosa	Little Epaulettetree
Pyrus calleryana 'Aristocrat'	Aristocrat Callery Pear
Pyrus calleryana 'Bradford'	Bradford Callery Pear
Salix alba tristis	Golden Weeping Willow
Salix babylonica	Weeping Willow
Sorbus alnifolia	Korean Mountainash
Sorbus aucuparia	European Mountainash
Sorbus aucuparia Cardinal Royal	Cardinal Royal European Mountainash
Stewartia pseupocamellia	Japanese Stewartia
Styrax japonicus 'Kusan'	Kusan Japanese Snowbell
Syringea reticulata	Japanese Tree Lilac
Ulmus pumila var arborea	Narrow Siberian Elm

*When first true leaf is visible.

Table II

LATE FOLIATION* TREES WHICH START TO LEAF OUT BETWEEN MAY 15 AND MAY 27 IN THE LANDSCAPE TREE TRIALS AT THE NORTH WILLAMETTE EXPERIMENT STATION, AURORA, OREGON

Scientific Name	Common Name
Acer pseudoplatanus	Sycamore Maple
Acer saccharum 'Green Mountain'	Green Mountain Sugar Maple
Acer saccharum 'Sweet Shadow'	Sweet Shadow Sugar Maple
Albizia julibrissin	Silk Tree
Chionanthus virginicus	Fringe Tree
Cornus florida rubra (Some Strains)	Red Flowering Dogwood
Diospyros kaki	Oriental Persimmon
Diospyros virginiana	American Persimmon
Fagus sylvatica atropunica	Purple European Beech
Gleditsia triacanthos 'Sunburst'	Sunburst HoneyLocust
Lagerstroemia indica	Crepe Myrtle
Liquidambar styraciflua (medium or late)	Sweet Gum
Liquidambar styraciflua 'Palo Alto'	Palo Alto Sweet Gum
Magnolia fraseri	Fraser Magnolia
Nyssa sylvatica	Black Gum
Quercus coccinea	Scarlet Oak
Quercus palustris	Pin Oak
Quercus phellos	Willow Oak
Quercus Robur Fastigiata	Upright English Oak
Rhus typhina	Staghorn Sumac
Tilia cordata	Littleleaf Linden
Tilia cordata 'Greenspire'	Greenspire Littleleaf Linden

*When first true leaf is visible.

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AVERAGE HEIGHT AND WIDTH IN FEET OF EARLY DEFOLIATING TREES AFTER 5 AND 10 YEARS IN THE LANDSCAPE TREE TRIALS AT THE NORTH WILLIAMETTE EXPERIMENT STATION

		Average Height			Average Width		
	E.M.H.*	At Planting	At 5 Years	At 10 Years	At Planting	At 5 Years	At 10 Years
Acer negundo	40/60	11.9	17.8	28.2	3.0	11.5	20.5
Acer negundo variegata	40/50	8.0	14.2	23.3	2.5	9.9	17.1
Acer platanoides 'Drummondi'	50/60	3.0	17.8	26.8	0.0	6.5	13.9
Acer platanoides 'Fassen's Black'	50/60	9.6	16.1	23.2	1.5	7.4	14.3
Acer platanoides 'Schwedleri'	50/60	7.5	16.6	24.6	0.9	8.8	21.9
Acer rubrum 'Autumn Flame'	40/50	6.3	15.6	27.4	1.1	12.5	25.8
Acer rubrum 'Bowhall'	50/60	5.2	20.6	32.6	0.8	5.8	9.8
Acer rubrum 'Scanlon'	50/60	10.8	22.8	34.4	2.6	6.0	11.2
Acer saccharum 'Green Mountain'	70/80	8.3	18.6	28.8	1.1	7.7	18.5
Betula maximowicziana	40/50	5.4	13.3	26.5	1.5	7.3	21.5
Betula papyrifera	70/80	6.0	19.3	30.9	1.9	8.5	15.7
Betula pendula gracilis	50/60	8.6	21.6	36.2	2.6	7.5	16.7
Cercidophyllum japonicum	40/50	4.0	13.6	23.2	2.6	7.0	14.2
Corylus colurna	50/60	7.5	16.2	18.3	2.5	9.4	13.3
Fraxinus pennsylvanica 'Summit'	50/60	6.9	13.1	20.7	0.0	5.6	12.0
Glenitsia triacanthos 'Rubylace'	40/50	3.6	9.2	17.9	0.0	9.5	19.9
Gleditsia triacanthos 'Shademaster'	60/70	4.9	12.1	26.9	2.0	10.6	20.1
Gleditsia triacanthos 'Skyline'	60/70	2.8	12.5	27.2	0.0	10.1	20.7
Gleditsia triacanthos 'Sunburst'	50/60	7.8	13.7	27.6	2.0	10.6	24.8
Nyssa sylvatica	40/50	2.8	7.3	17.3	0.8	6.5	12.7
Phellodendron amurense	30/40	1.5	10.9	22.4	0.5	8.0	21.2
Tilia americana	50/60	6.6	17.0	27.8	0.6	11.4	20.0
Tilia cordata	50/60	7.3	17.0	30.7	2.9	12.3	25.6
Tilia cordata 'Greenspire'	50/60	6.1	18.2	29.4	2.4	11.0	24.4

*Expected Mature Height in 30 to 40 years.

May. Also many of these late defoliating trees drop their leaves over a long period of time so that leaf raking becomes an endless chore.

Several Birch and Maples as well as other species which grow large enough to shade a building are found in Table II, the early defoliating trees. Although the Box Elder *(Acer negundo)* produces many seedlings, its variegated form doesn't seem to produce seedlings and gives a cool green effect. On the list are three forms of Norway Maple *(Acer platanoides* 'Drummondi' with green and white variegated leaves, 'Fassen's Black' with maroon leaves all season, and 'Schwedler' with red leaves early which become dark green later). *Acer rubrum* 'Autumn Flame' is a round headed tree which is usually the first tree to develop fall color and to defoliate each year. 'Bowhall' and 'Scanlon' are other early defoliating *A. rubrums* but have a columnar habit so are not good shade trees.

Two of the birch, *Betula papyrifera* (Paper Birch) and *B. pendula gracillis* (Cut Leaf European Birch) are fast growing tall trees but have a narrow habit so do not cast much shade. The *B. maximowicziana* (Monarch Birch) at the North Willamette Experiment Station is probably a hybrid but it does have a good rounded head and white bark.

Continues on page 26

Acer saccarum 'Green Mountain' Sugar Maple provides a relatively early fall color and defoliation which allows the sun's warming rays to penetrate through this tree.

Table III

EARLY DEFOLIATION* TREES WHICH DEFOLIATE BETWEEN OCTOBER 12 AND NOVEMBER 5 IN THE LANDSCAPE TREE TRIALS AT THE NORTH WILLAMETTE EXPERIMENT STATION, AURORA OREGON

Scientific Name	Common Name	Scientific Name	Common Name
Acer ginnala	Amur Maple	Diospyros virginiana	American Persimmon
Acer negundo	Box Elder	Fraxinus pennsylvanica 'Summit'	Summit Green Ash
Acer negundo variegatum	Variegated Box Elder	Gleditsia triacanthos inermis	Thornless Honey Locust
Acer platanoides 'Drummondi'	Drummond Norway Maple	Gleditsia triacanthos 'Rubylace'	Rubylace Honey Locust
Acer platanoides 'Fassen's Black'	Fassen's Black Norway Maple	Gleditsia triacanthos 'Shademaster'	Shademaster Honey Locust
Acer platanoides 'Schwedleri'	Schwedler Norway Maple	Gleditsia triancanthos 'Skyline'	Skyline Honey Locust
Acer rubrum 'Autumn Flame'	Autumn Flame Red Maple	Nyssa sylvatica	Black Gum
Acer rubrum 'Bowhall'	Bowhall Red Maple	Phellodendron amurense	Amur Cork Tree
Acer rubrum 'Scanlon'	Scanlon Red Maple	Prunus subhirtella 'Autumnalis'	Autumnalis Flowering Cherry
Acer saccharum 'Green Mountain'	Green Mountain Sugar Maple	Syringa reticulata	Japanese Tree Lilac
Asimina triloba	Paw Paw	Tilia americana	American Linden
Betula maximowicziana	Monarch Birch	Tilia cordata	Little-Leaf Linden
Betula papyrifera	Paper Birch	Tilia cordata 'Greenspire'	Greenspire Little-Leaf Linden
Betula pendula gracilis	Cutleaf European White Birch		
Cercidiophyllum japonicum	Katsuratree		
Cornus florida fastigiata	Upright Flowering Dogwood		
Corylus colurna	Turkish Hazel		

*Time of complete defoliation.

Table IV

LATE DEFOLIATION* TREES WHICH DEFOLIATE AFTER DECEMBER 5 IN THE LANDSCAPE TREE TRIALS AT THE NORTH WILLAMETTE EXPERIMENT STATION, AURORA, OREGON

Scientific Name	Common Name	Scientific Name	Common Name
Acer obtusatum		Liquidambar styraciflua 'Palo Alto'	Palo Alto American Sweet Gum
Betula pendula verrusoca	Clump European White Birch	Magnolia soulangeana	Saucer Magnolia
Carpinus orientalis	Oriental Hornbeam	Malus floribunda	Japanese Flowering Crabapple
Celtis sinesis	Chinese Hackberry	Ostrya carpinifolia	European Hophornbeam
Cercis silguastrum	Judas Tree	Parrotia persica	Persiam Parrotia
Cornus nuttalli 'Goldspot'	Goldspot Pacific Dogwood	Prunus cerasifera 'Thundercloud'	Thundercloud PurpleLeaf Plum
Crataegus 'Autumn Glory'	Autumn Glory Hawthorn	Pterostyrax corymbosa	Little Epaulettetree
Crataegus lavallei	Carriere Hawthorn	Pyrus calleryana 'Bradford'	Bradford Callery Pear
Fagus sylvatica atropunica	Purple European Beech	Quercus aliena	Oriental White Oak
Laburnocytisus adami	Adams Laburnocytisus	Quercus coccinea	Scarlet Oak
Laburnum alpinum pendulum	Weeping Scoth Laburnum	Quercus douglasi	Blue Oak
Laburnum Watereri 'Vossi'	Vossi Laburnum	Quercus lobata	Valley Oak
Liquidambar formosana	Chinese Sweet Gum	Quercus palustris	Pin Oak
Liquidambar formosana 'Afterglow'	Afterglow Chinese Sweet Gum	Quercus robur fastigiata	Upright English Oak
Liquidambar orientalis	Oriental Sweet Gum	Quercus shumardi	Shumard Red Oak
Liquidambar styraciflua	American Sweet Gum	Robinia ambigua 'Idahoensis'	Idaho Locust
Liquidambar styraciflua 'Burgundy'	Burgundy American Sweet Gum	Salix babylonica	Weeping Willow
Liquidambar styraciflua 'Festival'	Festival American Sweet Gum	Styrax japonica 'Kusan'	Kusan Japanese Snowball
Liquidambar styraciflua 'Gumball'	Gumball American Sweet Gum	Zelkova serrata 'Village Green'	Village Green Sawleaf Zelkova

*Time of complete defoliation

Several less common trees such as Katsura, Turkish Hazel, Black Gum, and Amur Cork Tree as well as Summit Green Ash and American Linden, are additional early defoliating trees. *Cercidophyllum japonicum* (Katsura tree) grows at a moderate rate, forming a medium sized tree with good fall color. *Corylus colurna* (Turkish Hazel) forms a medium to large pyramidal tree with edible nuts. *Nyssa sylvatica* (Black Gum) is a medium size tree with good fall color that tolerates wet soils but is difficult to transplant. *Phellodendron amurense* is a medium sized tree which produces filtered shade over a wide area. *Fraxinus Pennsylvanica* 'Summit' (Summit Green Ash) develops into a large upright oval tree. *Tilia Americana* (American Linden) grows into a large tree with large heart-shaped leaves producing dense shade.

Summary

Deciduous trees can reduce heating and cooling costs for home and other small buildings by intercepting solar radiation during the hot part of the year and letting it through during the cold season. Their transpiration provides evaporative cooling during the summer and their bare branches reduce wind velocity in the winter to lower heating costs. **WTT**

VEGETATIVE WINDBREAKS MAKE EXCELLENT HOME INSULATORS

By Donald Hanley, Extension Forester, University of Idaho, Moscow, ID

A windbreak is a vegetative or mechanical barrier that is designed to reduce or eliminate undesirable effects of strong winds. Mechanical barriers, constructed of slats or narrow boards with about 50 percent density in the upper two-thirds of its height and 25 percent density in the lower third, will normally reduce open wind velocities by 40 to 60 percent on the lee side zone lying between 3 and 10 times the barrier's height.

The main advantage of mechanical barriers is that they require little space and no waiting period for protection. However, the main disadvantage to mechanical barriers is that they can not be constructed very tall. About 6-10 feet in height is the maximum practical height, especially where there are heavy snow loads. Vegetative barriers, on the other hand, often grow 60-70 feet in height depending on the species used.

Because of the severe limitation to mechanical barriers such as height, anchoring, and cost, the rest of my remarks will address vegetative barriers. Windbreaks, then, I will define as vegetative barriers.

There are two basic types of windbreaks depending on their location and what they are protecting. The first is a farmstead windbreak. A farmstead windbreak is used to protect the main farmhouse or outbuildings from winds and snow drifts. The second main type is a field windbreak designed to protect crops and livestock for increased yields and better performance.

Windbreak Benefits

Probably the single most important benefit of a farmstead windbreak is the reduction of energy required to heat a home. Recent studies (4) of windbreaks show that windbreaks can reduce winter fuel consumption by 10 to 30 percent. For example, one study in Nebraska compared the fuel requirements of identical test houses which maintained a constant inside temperature of 70°F. The house protected by a windbreak used 23 percent less fuel.

Two identical electrically heated homes in South Dakota were compared for energy usage. One was sheltered by a farmstead windbreak and the other was not. Inside temperatures were maintained at 70°F. The sheltered home used 34% less electricity—quite a sizeable savings in today's energy market.

In addition to reducing the force of the wind, windbreaks also can reduce the wind chill impact on people outside the house.

Studies of three-row windbreaks, where trees were 25 feet tall, show that wind velocities and the wind chill index were effectively reduced (Figure 1).

Energy savings can be further enhanced by the use of foundation plantings (Figure 2). Trees and shrubs planted closely to buildings reduce wind currents. These foundation plantings create a "dead air" space which slows the escape of heat from a building. Please notice that deciduous plantings are made on the south and southwest sides of the home to block the sun in the summer, but allow the warming rays in the winter to come through.

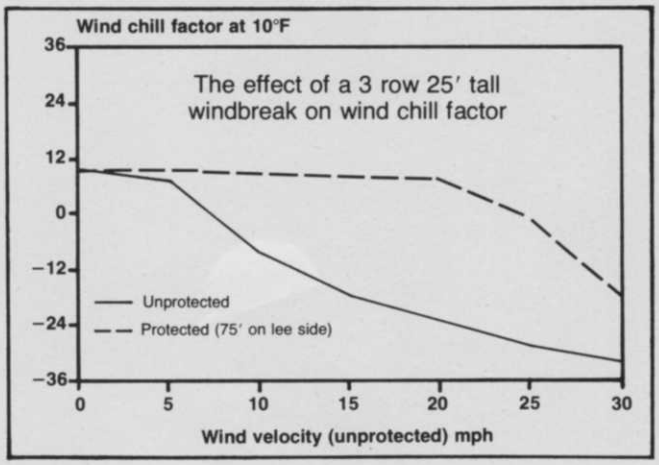

Figure 1

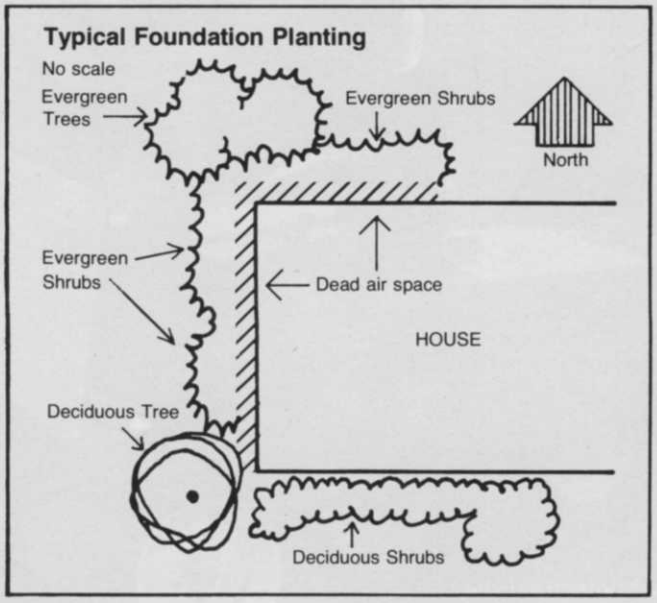

Figure 2

It has long been recognized that increased crop yields is a windbreak benefit. This data is variable, however. E. J. George (2) reports that a South Dakota study showed an increase in corn of 8-9 bushels per acre, while alfalfa increased ¾ ton per acre. In Idaho he reports potatoes increased by 80 bushels per acre. Some researchers attribute a portion of the yield increases to increased soil water penetration from snow drifts.

I have talked with numerous farmers in southern Idaho who have indicated to me that their crops "look better" in the leeward side of a windbreak. Unfortunately I know of no economic study that compares the benefits and costs of a windbreak.

Windbreaks provide improved habitat for small mammals and birds. A 1970 survey of 180 Idaho wind-

Continues on page 30

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break owners reported that over 30 percent of them were enthusiastic about the use of the trees by birds. The Idaho Fish and Game Department regularly plants windbreaks as nesting, brooding, and loafing areas for Chinese pheasants. The United States Forest Service is in the middle of a ten-year program to plant 75,000 Russian olive seedlings normally in southern Idaho on the Curlew National Grass Range for bird habitat. An excellent publication by Martel and Vohs (3), of Oregon State University, lists plants attractive to wildlife in the Pacific Northwest.

Windbreak Establishment

To survive and make satisfactory performance as a windbreak, young trees will need:

1. To be planted according to a sound plan.
2. A favorable climate and a suitable soil.
3. To be carefully handled and planted.
4. To have adequate moisture.
5. To be kept free of weeds.
6. To have protection from livestock and other damaging agents.

Windbreak planning is by far the most important step as the planning phase will determine the location, size (number of rows), tree spacing, and the tree species used.

In general, most settled areas below 5,000 feet elevation in this region have quite a favorable climate for growing windbreak trees. The lack of natural rainfall usually is not limiting because of modern irrigation practices.

However, a deep, well-drained loam soil with neutral pH and average fertility is ideal for growing a variety of trees. Species modifications will have to be made on sites with poor soils. In Idaho our major soil problems relate to iron, phosphorus, and zinc deficiencies, which are easily corrected with fertilization.

Location

Locate your windbreak at a right angle with the prevailing winds as nearly as possible. Figure 3 offers some suggestions on how windbreaks can be designed. Note how roadways cross the windbreak at nonperpendicular angles.

Place your windbreak about 100 feet from the house for maximum effectiveness. If you have considerable snow and wind in your locality, then locate your windbreak about 100-150 feet from buildings, driveways, or areas that need to stay free of drifts (Figure 4). A windbreak planted closer than 60 feet to the house or other main areas of the farmstead will be somewhat of a hindrance in snow country because of the deposition of the snow.

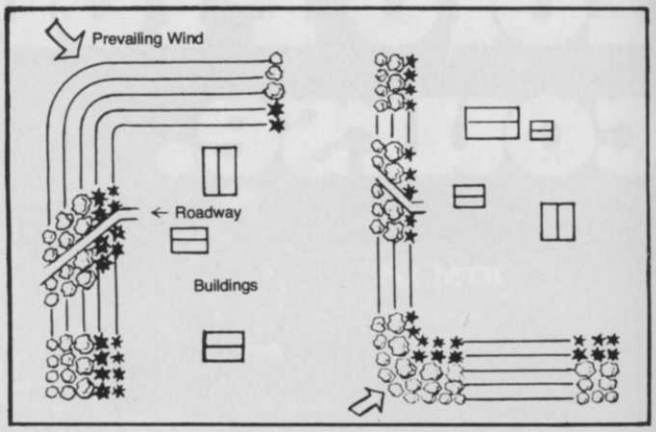

Figure 3

Extend your windbreak at each end 50 feet beyond the boundaries of the farmstead.

The location of a field windbreak will have to conform to maximum expected wind velocity, field boundaries, irrigation systems, power lines, roads, and soil type.

In this region, fields that are subject to severe wind erosion may require multiple-row planting along the windbreak border, supplemented by parallel single-row plantings at intervals of 500 feet or less (Figure 5). The usual velocity of erosive winds in your locality and the nature of your soil will determine the best intervals to use between the supplemental plantings. If the usual maximum wind velocity in your locality exceeds 30 miles per hour and you have light soils, place the supplemental windbreaks 350 feet apart. Under less severe conditions, tall trees in single-row plantings spaced 600 feet to ¼-mile apart will give adequate protection.

Windbreak size (number of rows)

My recommendation on windbreak size is to establish a five row windbreak whenever possible (Figure 6). Most owners that are contemplating the establishment of a windbreak are doing so because they have a wind problem. Five rows give the best protection.

If limited space prevents your planting a five-row windbreak, then use fewer rows rather than crowding your trees. Crowding trees in a windbreak causes a loss of vigor due to severe competition among the trees as they grow to mature size. Crowded trees slow down in growth and stagnate—reach a point where they make almost no growth—at an early age. The planting becomes more susceptible to wind whipping injuries and losses from insects, diseases, and drought. Lower limbs die out early from too much shade in an over-

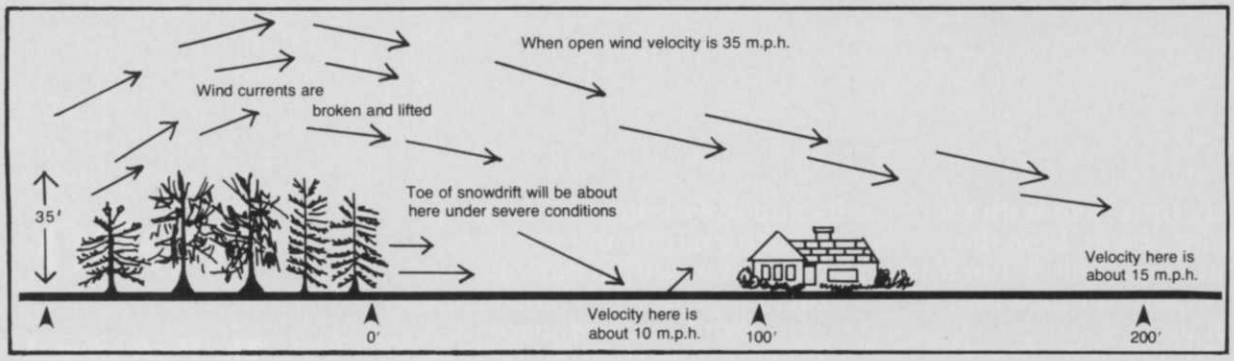

Figure 4

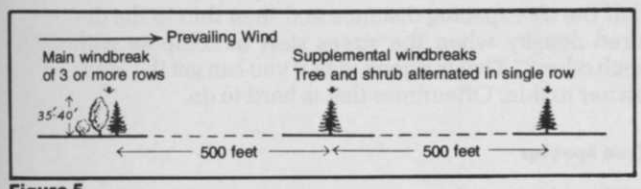

Figure 5

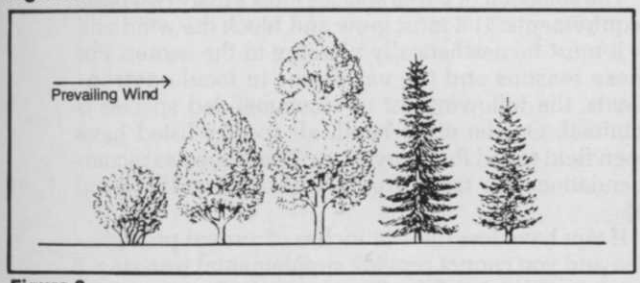

Figure 6

If you have room for only	SELECT	OR	SELECT
4 rows	Dense shrub Medium height evergreen Tall evergreen Medium height evergreen		Dense shrub Medium height deciduous Tall evergreen Medium height evergreen
3 rows	Dense shrub Tall evergreen Medium height evergreen		Dense shrub Tall deciduous Medium height evergreen
2 rows	Medium height evergreen Tall evergreen		Dense shrub Tall evergreen
1 row	Medium height evergreen		Tall evergreen

crowded planting, thus making the windbreak much less effective. Three rows with room to develop will give better results than five rows that are seriously overcrowded. A well developed single row can be more satisfactory than three rows with inadequate growing space.

If you must use fewer than five rows, select the following combinations to give the maximum year-round protection for your site:

Please notice I do not recommend a one row deciduous windbreak for year-round protection, even though we see many, many one row lombardy poplar breaks. However, sometimes a tall lombardy poplar is alternated with a dense shrub such as caragana in a single row. I would recommend this arrangement only where evergreens do poorly and protection is needed mainly in the summer.

Tree Spacing

Spacings for windbreak trees vary by the type of tree and/or shrub used because it is very desirable to give trees room to reach mature size. Table 1 gives the *minimum* spacings recommended for windbreak trees. Wider spacing can be used with no disadvantage ex-

Continues on page 32

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Table 1. Recommended minimum spacings for windbreak trees

	Recommended minimum spacings			
	Irrigated or dryland with 16" or more precipitation.		Dryland plantings with 16" or less precipitation.	
Tree and Shrub types	Multiple-row windbreaks	Single-row wind-breaks	Multiple-row windbreaks	Single-row wind-breaks
	(feet)	(feet)	(feet)	(feet)
All types (between rows)	16		20	
Dense shrub	3	2	4	3
Medium-size deciduous	9	6	10	8
Tall deciduous	12	8	12	10
Medium evergreen	9	6	10	8
Tall evergreen	12	8	12	10

cept that it will take longer to get full protection. I believe you will find these recommended distances appear to be quite large, especially if you are planting small 2-0 or 2-1 stock. Please remember these distances will be adequate for mature trees. Additionally, the spacings recommended between rows and between trees within rows will leave adequate room for use of your tillage equipment; provide your trees with ample room for good growth; avoid wind whipping damage to trees in adjacent rows; and prevent early dieback of the lower limbs.

The question is often asked, "Why not plant at one half the tree spacing distance and then thin to the desired density when the strees start to compete with each other?" That is a good idea *if* you can get the landowner to thin. Oftentimes that is hard to do.

Tree species

The selection of a tree species must satisfy two basic requirements: 1) it must grow and block the wind and 2) it must be aesthetically pleasing to the owner. For these reasons and the variations in local environments, the following list of recommended species is minimal. On the other hand, all species listed have been field tested for many years. These species recommendations are taken from *Trees Against the Wind* (1).

If you have less than 16 inches of annual precipitation and you cannot provide supplemental watering, I recommend using Siberian peashrub, Russian olive, Siberian elm, black locust, ponderosa pine, and Austrian pine.

The most reliable species for high elevation plantings are Siberian peashrub, common lilac, golden willow, hybrid poplar, ponderosa pine, blue spruce, and Rocky Mountain juniper.

Evergreen trees can be called the foundation for windbreaks in all areas where they can be grown satisfactorily as they give year-round protection. They should be included in windbreaks wherever possible. In areas where they do well, evergreens may be used for the entire windbreak. However, a windbreak of mixed species gives some protection against insects or diseases damaging the entire planting.

Continues on page 34

Table 2. Recommended windbreak species

DENSE SHRUBS NAME	Mature Height	Crown Width	Minimum Precipitation	Saline Soil Tolerance	Winter Damage Resistance
	(feet)	(feet)	(inches)		
Siberian peashrub *Caragana arborescens*	10	10	12	Excellent	Good
A dense, attractive, many-stemmed shrub. Makes rapid growth. Has long life, wide range of soil and elevational adaptability. Generally insect and disease free. Sprouts from crown only. Good for dryland or irrigated plantings. Reaches full size on irrigated land in 5 to 7 years, on dryland in 10 to 12 years. Can be trimmed to make an excellent protective hedge. A superior windbreak shrub adaptable to the whole region. It is weakened by repeated 2, 4-D exposures.					
Common lilac *Syringa vulgaris*	10	10	15	Good	Excellent
Very dense. Slow to medium growth rate; long lived; wide soils and elevational adaptability. Sprouts heavily, mainly at the root crown, but spreads slowly. Makes excellent hedge or shrub row in windbreak. Has high aesthetic value. Occasionally becomes infested with scale insects; extremely sensitive to 2, 4-D. Has high resistance to drought and cold.					
Tatarian honeysuckle *Lonicera tatariea*	8	7	15	Fair	Excellent
Attractive global-shaped, many stemmed shrub. Bears numerous pink or white flowers. Red fruit holds on till fall. Provides good wildlife food and cover. Not commonly subject to insect or disease problems. Does well on most soils.					
Common privet *Ligustrum vulgare*	10	8	15	Good	Good
An extremely dense, attractive shrub with medium to rapid growth. Needs well-drained soil. Sprouts only from crown. A nearly ideal plant for low single-row windbreaks, as well as the shrub row in multiple-row plantings.					
NAME	Mature Height	Crown Width	Minimum Precipitation	Saline Soil Tolerance	Winter Damage Resistance
	(feet)	(feet)	(inches)		
Nanking cherry *Prunus tomentosa*	6	4	15	Fair	Good
An attractive upright shrub with a fast growth rate. Produces abundant edible fruit that makes good jelly. Fruit is retained throughout the winter and makes good wildlife food. Some hybrid varieties grow to 10 feet tall. Has fair to good windbreak qualities. No known insect or disease problems. Nanking cherry should not be planted near cherry orchards because it is an alternate host to Western X cherry disease.					

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Peking Cotoneaster
Cotoneaster acutifolia 5 4 12 Fair Good
Similar to Nanking cherry. Will grow on severe sites. Moderate growth rate. Withstands drought well. Produces abundant fruit that is retained throughout the winter. An excellent species for adding wildlife value to a windbreak. Few insect or disease problems.

Mugo pine
Pinus mugo 8 8 20 Fair Fair
An attractive, compact evergreen shrub with moderate growth rate. Does best on fertile, well-drained soils. Performs best as a windbreak shrub at elevations below 4,500 feet as winter burning is a problem over this elevation.

DECIDUOUS TREES

Russian-olive
Eleagnus augustifolia 30 20 12 Excellent Excellent
A small tree with dense, attractive crown. A superior tree for windbreak, wildlife, and aesthetic values and for drought resistance. Makes a dense hedge when clipped. Its spiny-tipped twigs make a dense planting an almost impenetrable barrier. Considered to be one of the best deciduous species for dryland plantings in the region. Makes very rapid growth especially on good soil with ample moisture. It is adapted to a wide range of soils. Sprouting is negligible, but it spreads by seed where there is adequate soil moisture. More resistant to spray damage than other deciduous species, but not as resistant as evergreens.

Golden willow
Salix alba var. *vitellina* 35 30 15 Good Excellent
A medium-size tree with good growth form for windbreak use. Bright yellow to orange colored young branches make it attractive in winter. Makes very rapid growth; has wide adaptability to soil and moisture conditions. Sprouts only from crown and does not spread from runners. Subject to severe damage from scale insects and aphids. Should be used in dryland plantings only if supplemental moisture is available. Excellent in the Palouse.

NAME	Mature Height	Crown Width	Minimum Precipitation	Saline Soil Tolerance	Winter Damage Resistance
Black willow	(feet)	(feet)	(inches)		
Salix nigra	40	35	20	Excellent	Excellent

Grows very rapidly under irrigation. Forms broad, global crown that is moderately dense. Usually has several stems from near ground level. Serves well as a middle row in windbreaks. Not very suitable for single row plantings because of its low wide spreading branches. Has performed well in localities with salty soils and high water tables where establishment of other species was difficult. Subject to damage by scale insects.

Black locust
Robinia pseudoacacia 50 40 15 Fair Fair
Has rapid growth rate. Forms moderately dense crown. Tolerates very hot climates. Adapts to a wide range of soil conditions, but does not stand waterlogging. Seldom damaged by insects or disease. Not recommended for ditch bank or fence row plantings because injured roots produce thickets of sprouts. Confine black locust between other rows of trees to prevent spreading on irrigated land. Suckering is not serious on dryland. Requires little maintenance once it is established. A well-liked and widely used tree with good shade, aesthetic, and wildlife values.

Honeylocust
Gleditsia triacanthos var. *inermis* 40 20 12 Good Fair
Medium to tall tree. Fairly drought resistant. Withstands alkaline soils well. Attractive zigzag twigs, fine textured leaflets. Two to four inch thorns. Fruit is a large 12" (max.) pod. Winter injury on harsh sites.

Siberian elm
Ulmus pumila 50 30 12 Excellent Good
Has moderately dense crown and attractive form. Makes rapid growth. Adapted to a wide range of conditions. Branches usually become brittle in irrigated plantings. This often results in breakage and an untidy appearance. Pruning can reduce this. Sprouting is not a problem, but thickets of seedlings often form around irrigated plantings. Severely damaged from repeated exposure to herbicides applied as crop sprays. Sudden fall freezes can cause severe damage. Susceptible to scale insects. Very drought resistant but has not stood up well in Oregon and Columbia Basin. A very acceptable dryland tree in Idaho up to 5,000 feet. (Note: Chinese elm. *U. Parvifolia* is quite similar.) Resistant to Dutch elm disease.

Hybrid poplar
Populus x spp. 50 30 15 Good Excellent
Makes very rapid growth. Has dense crown and good form. Does best under irrigation, but performs well in dryland plantings with 15" or more annual precipitation. Provides quick protection. Suckers from injured roots. Do not plant near field drains or along irrigation ditches. A well liked tree that is growing in popularity. Susceptible to poplar and willow borer. (Note: There are many hybrid poplars. The one described here is a selection that was made from early Idaho test plantings of hybrid poplars.)

NAME	Mature Height	Crown Width	Minimum Precipitation	Saline Soil Tolerance	Winter Damage Resistance
Green ash	(feet)	(feet)	(inches)		
Fraxinus pennsylvanica var. *lanceolata*	60	40	15	Good	Good

A deep rooted, long lived tree with dense, symmetrical and attractive crown. Growth may be slow at first, but moderate to rapid after becoming established. It will become overtopped by more rapidly growing trees, such as black locust and Siberian elm, if planted too close to them. Sprouting is negligible. An excellent tree for ditch bank and fence row plantings. It is more winter hardy and salt tolerant than black locust. It is damaged by herbicide sprays, but is more resistant than Siberian elm. Subject to damage by scale insects and aphids.

Lombardy poplar
Populus nigra var. *italica* 70 15 20 Good Excellent
Grows very rapidly, reaching 40 feet in 12 years under favorable conditions. Has very narrow, though fairly dense, crown. Makes good middle row where fast growth and extra windbreak height are desired. Subject to some canker diseases and heart rot, especially if trees have been damaged by topping, fire, or other causes. Windfirm unless diseased. Susceptible to poplar and willow borer. Competes with nearby crops for soil moisture and nutrients. Short lived.

EVERGREENS

Rocky Mountain juniper
Juniperus scopulorum 20 15 12 Excellent Excellent
Makes medium to rapid growth. Forms very dense, symmetrical crown. Adapted to wide soil variations. Tolerates high water table. A superior small windbreak tree for this region. Bare-rooted planting stock is difficult to establish on dryland, but does well once established. Subject to damage by spider mites and is sometimes a host to cedar-apple rust.

Eastern redcedar or Virginia juniper
Juniperus virginiana 25 15 15 Good Good
Has moderate to fast growth rate. Similar in appearance to Rocky Mountain Juniper and generally as adaptable. It is easily established except on very dry sites and at high elevations. Well liked for single row screens. Subject to attack by cedar-apple rust. Should not be planted near apple orchards.

Northern white cedar
Thuja occidentalis 35 20 20 Good Good
Moderate growth rate. Forms very dense, attractive crown. Holds lower branches well. Makes a dense single-row windbreak or leeward row in a multiple-row planting. Survives well under irrigation where soils are not highly saline. No known insect or disease problems. Has not been widely used, but existing plantings indicate it is a good tree for many localities. It is well liked in Oregon for single-row screens and windbreaks.

NAME	Mature Height	Crown Width	Minimum Precipitation	Saline Soil Tolerance	Winter Damage Resistance
	(feet)	(feet)	(inches)		
Austrian pine *Pinus nigra*	40	30	20	Fair	Good

Has medium growth rate. Develops symmetrical crown that is very dense for a pine. Some maintain the density of one row of Austrian pine is equivalent to that of two rows of ponderosa pine. Holds lower branches well. An excellent tree under irrigation, but has failed in some dryland plantings with low rainfall after 10 to 12 years. If planted without supplemental watering in localities with less than 20-inch annual precipitation, it needs a deep, fertile soil with good moisture holding capacity. Austrian pine is considered an excellent species

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for the Columbia Basin. Ponderosa pine is preferred in Wasco, Gilliam, Sherman, and Morrow counties, Oregon. Usually remains free of insect and disease problems. Susceptile to iron chlorosis.

Scotch pine
Pinus sylvestris 40 20 15 Fair Good
Has rapid growth rate. Crown density is usually medium. Lower branches shade out and die if they do not get full sunlight. Adapts to a wide variety of soil conditions. Will withstand permanently moist soil conditions better than ponderosa. Generally easy to establish. A widely used tree for windbreaks. There are many strains of Scotch pine. Some have poor form. Spanish burgo variety does well in Idaho.

Blue spruce
Picea pungens var. *glauca* 40 25 20 Good Excellent
Growth rate is unusually slow for first 5 years after planting but has medium growth rate after that. Crown is very dense with attractive pyramidal form. Makes an excellent windbreak species in most of the region. Color varies from green to blue. Sometimes it is difficult to establish. Subject to damage by spider mites, scale insects, and spruce gall aphid.

Norway spruce
Picea abies var. *bavaria* 60 25 16 Fair Fair
Makes rapid growth. Develops a very dense crown that extends to the ground unless the base of the crown is in heavy shade. Moisture and soil fertility requirements are higher than for the pines. Does fairly well in dryland plantings if soil is deep and fertile. Subject to spider mite and and spruce bud scale damage. Sometimes becomes stunted in growth due to zinc deficiency.

Ponderosa pine
Pinus ponderosa 60 30 15 Fair Good
Has moderate growth rate. Crown is symmetrical and fairly dense. Needs full sunlight for best development so lower branches shade out and die under close spacing. Adapts well to a variety of soil conditions but must have good drainage. Withstands hot, dry sites well. Can be damaged or killed by too much irrigation. Generally free of insect and disease problems. Considered by many to be the most reliable evergreen for windbreaks. Highly preferred in Oregon and in much of the Columbia Basin.

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BENEFITS OF WOOD BIOMASS MAKE CULTIVATION ESSENTIAL

By Paul Heilman, Forest Scientist, Washington State University, Western Washington Research and Extension Center, Puyallup, WA

Plant materials, or biomass, already contribute significantly to energy supplies throughout the world. Even in the United States where such usage is confined primarily to fuelwood and wood wastes burned by wood processing plants, the quantity of energy generated from biomass is important — over 1.5 percent of the total consumption in the U. S. (currently 75 quads of energy). Although significant, such figures show the U. S. to be far from the goal of certain other countries to make biomass fuels a large component of energy use. Some examples:

1. Brazil is attempting with high capitalization and technology to produce ethanol from crops grown for that purpose. The ethanol is intended as a major source of liquid fuels for automobiles. Their program had progressed to the point where several large distilleries are already in production. The crop for this purpose is manioc, a root crop which is adapted to relatively infertile soils and can be grown satisfactorily without irrigation. Livestock production is incorporated into these operations in order to utilize the waste and increase efficiency.
2. Red China has begun a program to provide small scale units on individual farms for production of methane through anaerobic decomposition of farm manure and human wastes. The methane produced would be used at the farmstead for cooking and other purposes.
3. Perhaps the most optimistic program for energy production from biomass is in Sweden. In April, 1980, at a Conference in Atlanta, Georgia, I listened to representatives of that country forecast that by the year 2015 Sweden would have the potential to produce up to 60 percent of its energy from biomass with 45 percent from biomass farms using willows and 15 percent from conventional forestry residues. This would allegedly be achieved with a continued increase in the country's standard of living and yet with only 6 to 7 percent of the total land of Sweden being devoted to the willow plantations.

Potential in the United States

Most analyses show a substantial potential contribution to future U. S. energy consumption from biomass (about 5 percent). Such energy would be in the form of fuelwood for homes; forest and mill wastes used onsite for mill power and cogeneration of electricity for nearby communities; agricultural and food processing wastes used on the farm and at the food processing plants, forest, farm, and city wastes used for electrical production and gasification at central locations; and biomass produced from both terrestrial and aquatic environments also used in central systems for production of electricity and gas.

Within the United States there are considerable differences among regions with respect to options for biomass production and energy recovery. For instance, the Northeast with rural populations, cold winters, and abundant woodlands already uses large quantities for fuelwood for home heating. Also, chips from natural stands of small dimension hardwood stands are likely to be utilized in small centralized systems for energy conversion.

Two clones of poplar hybrids at 1½ years illustrate experimental biomass plantings for energy or fiber. Trees were spaced 4 feet apart.

The Southeast, also with a considerable rural population, has a relatively smaller potential for fuelwood usage. This area also has an abundance of low quality natural hardwood stands which could be chipped and used in central systems. Following the harvest of such forests, the material for such systems could be provided from biomass farms using rapidly growing species.

The Pacific Northwest has a high proportion of productive forest land and also relatively high timber and pulp chip values due primarily to export markets. If these timber values remain high, the region is likely to be hard pressed to provide future fuelwood needs for home heating. Together, the high projected demand for timber, pulp, and firewood in the Pacific Northwest may make high production tree plantations more economically feasible than in other regions. Such plantations could be sufficiently versatile to provide fiber, cordwood, or biomass fuel depending upon needs and markets at harvest. Such plantations are potentially suitable for much of the underused and marginal agricultural lands and certain forest lands in the Pacific Northwest.

Increasing yield potential of woody plants

Rapid growth is not necessarily of adaptive significance to trees; rather, such characteristics as wind firmness, disease and insect resistance, and drought resistance are likely more important in natural selection since with such traits a tree can survive long enough to be effectively reproductive. For instance, we now realize that Douglas fir, although active photosynthetically during the winter months, frequently closes its stomata during warm and sunny periods of the day even though soil moisture supplies may be adequate for continued transpiration and photosynthesis. Consequently, the tree may not fully utilize soil moisture and, thus, may not capitalize fully on periods with high photosynthetic potential.

Furthermore, although conifers are the most productive timber trees in the Pacific Northwest, the growth rate of these species during early years is generally quite slow. For instance, a 26-year-old stand of western hemlock from the Oregon Coast was found to have a current annual biomass production of 11 tons dry weight per acre per year, equal or higher than the most productive world forests, including tropical rain forests. Despite this high rate of production at age 26, the average production for the entire 26-year period of that stand was only 2.9 tons per acre per year. Average production of less rapidly growing stands of conifers would, of course, average even lower.

Several years ago some forest scientists in the Southeast proposed a new approach to forest production for fiber which they called "silage sycamore." The principle of the system was to use a fast-growing tree species, such as sycamore, in very dense plantations with harvest as often as every two years. The advantages of their system as they saw it were that 1) maximum growth rates would be achieved much more rapidly than from conventional forest plantations, 2) elimination of the need to replant after harvest by use of species that would readily resprout following cutting, 3) mechanical harvest with perhaps chipping at time of harvest, thus mechanizing the harvest operation, and 4) production of a relatively uniform product that could be readily transported in vans and could be conveniently handled by conveyor or blower.

Indeed, the first efforts to evaluate yields under such conditions were very encouraging. So much so that it now appears that the short rotation idea was somewhat oversold. To be sure, early yields are high under such a system, but more recent research with sycamore and other species shows higher yields can be obtained when the harvest cycle is increased from two years or so to eight years and more. Furthermore, at the older ages the yield advantage of close spacing is very much reduced. Also, the cost of stand establishment dictates wider spacing. Nevertheless, with today's interest rates, the advantage of shortening rotation time is obvious. Additionally, for the short term at least, resprouting has become a minor factor, since the rapid gains possible from genetic improvement make replacement of planting stock likely after the first or second harvest.

Research on woody biomass plantings

Use of fast growing hardwood species for maximum biomass production continues to receive major emphasis in work on growing woody biomass. Our research was conducted initially with Dwight Peabody, Western Washington Research and Extension Unit in Mount Vernon, and is now being done with Professor Reinhardt Stettler, forest geneticist, University of Washington, Seattle. The major emphasis of this work is with black cottonwood *(Populus trichocarpa)*, the native cottonwood of the Pacific Northwest and a species highly regarded in Europe where cottonwood planting and culture far predates Pacific Northwest efforts. Our attempts to improve the growth rate of black cottonwood include selection and intraspecific crosses with eastern cottonwood *(P. deltoides)*. One such hybrid planted near Sumner at a 10 x 10 foot spacing without irrigation grew 11 feet the first year from a 20-inch cutting planted 18 inches deep. On August 20th, I measured this tree and it was 14.8 inches in diameter at breast height and 87 feet tall and it won't be 9 years old until this winter. This tree resulted from a cross using pollen collected from a superior *P. deltoides* from Mississippi and a randomly selected *P. trichocarpa* from western Washington. Such crosses with black cottonwood are easily made. Branches containing flower buds from a female *P. trichocarpa* are clipped early in the spring, placed in water and when the buds open they are dusted with the select pollen. Using *P. trichocarpa* as the female parent permits production of viable seeds on the clipped branches. In contrast, branches of *P. deltoides* must be grafted to rooted stock in order for viable seed to be produced.

Our first efforts at systematic selection of black cottonwood involved the collection of cuttings from 50 selected wild trees, 5 trees each from 10 stands located on the South along the Santiam River near Albany, Oregon, to the Chilliwak Valley on the North in southern British Columbia. Flowering branches and later seeds from these stands were also collected. The cuttings were planted on an irrigated site near Sumner, Washington, using 45 20-inch cuttings per clone. These were planted at 4 x 4 foot spacing in nine tree rows with five replications. Additionally, five representatives of the material, including hardwoods that we had been working with for some time, were used in the experiment for comparison. Average height growth of the first year for up to 45 individuals per clone ranged from 5.9 to 10 feet. The cuttings from the hybrid I mentioned earlier grew best but several clones of *P. trichocarpa* grew almost as high and were in fact not significantly different in height from the fastest growing hybrid. On August 20th, the best plants of this hybrid were 24 feet tall. These individuals will still grow another meter in height this year and these plants won't be two years old until this winter.

We intend to select not only for biomass production but also for trunk straightness and small branches because such features are likely to be related to effective utilization of growing space as well as timber quality. Thus, we expect that the materials selected for biomass production will also be suitable for timber production.

A feature of our work that I haven't mentioned is growth of mixed stands, primarily cottonwood-red alder mixture. The purpose of such mixtures is to obtain the benefit of nitrogen fixation by alder and perhaps avoid the need for nitrogen fertilization. Accordingly, we have planted 28 clones in a second experiment to test the effects of alder on cottonwood primarily from the standpoint of total biomass yield of the mixture. Earlier Dean DeBell, forest scientist, U. S. Forest Service, Olympia, Washington, reported benefits of such a mixture in terms of enhanced growth of cottonwood. In our experiment, we found after the first year, a significant, although small, increase in nitrogen content of cottonwood foliage on trees grown with alder. This year we have noted a large increase in both total foliage mass and a darker green foliage color in cottonwood associated with the alder. Such a rapid effect from alder was unexpected since the primary means

Continues on page 40

for alder to benefit associated plants has been thought to be through the accumulated forest litter and thus is a longer term process. Although inclusion of red alder in such mixtures shows great promise at this time, we have not begun efforts at genetic improvement of that species.

Yields and cultural practices

Highest yields reported to date are from willows in Sweden where 14 dry tons per acre per year are claimed. With irrigation we expect our best cottonwood clone to give similar yields, since our estimated production was 10 tons per acre for the first year. Without irrigation our best yield from wild stock black cottonwood at 4 x 4 foot spacing and for a four-year cutting cycle has been 4.1 dry tons per acre per year. The same material on a drier site with some grass competition gave 2.6 tons per acre per year at the same spacing and harvest cycle.

For satisfactory results, weeds and grass must be controlled at least during the first growing season. We have been satisfied with preplant herbicides or summer fallow together with minimal cultivation the first season. Dwight Peabody at Mount Vernon has tested many herbicides and has only recently had results showing some selectivity for two materials.

Best spacing depends upon rotation age. We recently obtained yields from a single harvest after eight years which averaged 40 percent more than from the combined yields from two four-year harvests. At eight years, yields were relatively independent of spacing up to 4 x 6 foot; whereas, with shorter rotations (four years or less) spacing is very important in the first harvest but less so in subsequent harvests. The major factor determining spacing and rotation age is size of material desired at harvest and this will vary according to harvest methods, markets, and so forth. We expect wide variation in such factors among regions and locations.

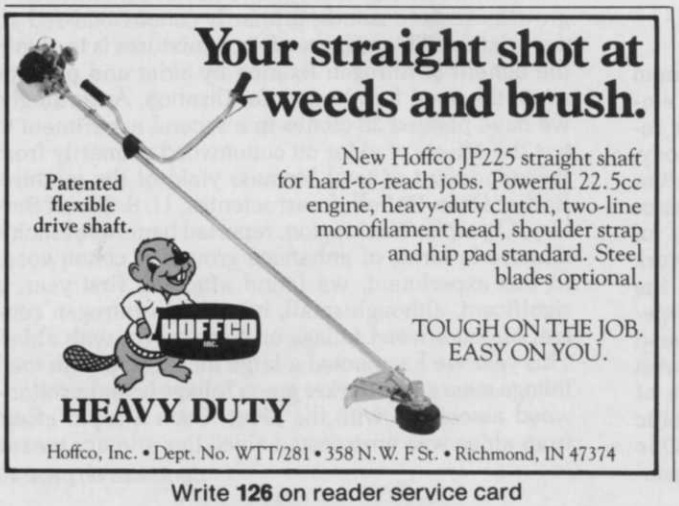
All planting is with cuttings, although stands can be readily produced using seedlings. With black cottonwood, cuttings can be of any age material, i.e., branches or sprouts. We use material from ⅜ to 1¼ inches in diameter. Cuttings are about 18 inches long and are placed in subsoiling trenches with about 2 inches left above ground. Such cuttings are collected in the winter months. Survival is high but can be improved for cuttings that have been stored by a 48-hour soak in water. Survival of certain of the hybrids with *P. deltoides* can be much lower, and soaking of these materials is recommended. Mid-season pruning to a single stem is also recommended, although it is not required for short rotation biomass plantings.

Fertilization with nitrogen is required on low organic matter status soils although we have not seen much response to fertilizer in the few instances where we have tried it. We are currently developing foliar analysis guidelines for use in determining nitrogen fertilization requirements.

Diseases have so far not been a problem as long as westside *P. trichocarpa* has been used. Eastside *P. trichocarpa* is not satisfactory for the westside because of the high susceptibility of these materials to a leaf rust under the more humid climate. Insects chew on these plants, but to date we have not felt the need for spraying. Distressed plants—from weed competition, dry soils, and newly planted seedlings—set their buds early in the season and can be severely affected by a bud infesting midge. More vigorous plants set buds much later, especially the terminal bud and by this means appear to avoid being infested.

Conclusions

1. Technology for several processes and end products using biomass to capture solar energy is being developed with the feasibility of each varying with specific growing conditions, needs, and other characteristics of a region or country.
2. Woody plant material is likely to represent a significant portion of the biomass used for energy in most areas.
3. Production of woody biomass offers diversification of markets, including not only energy uses but also pulp chips, cordwood, and timber.
4. Woody species plantations for biomass will likely vary from extensive plantations growing small dimension material in relatively short rotations, such as are planned for Sweden, to small wood lots and fence rows on small ownerships. In these cases, larger dimension trees will likely be grown at longer rotations and wider spacings.
5. Nitrogen fixing plants including trees such as red alder will be utilized in both pure stands and in mixtures with other trees.
6. Tree improvement programs will result in continually improved planting materials with selections and hybrids being developed for specific soil and site conditions.
7. The substantial requirements in land and water to bring about a significant increase in woody biomass production can result only from a new concern for conservation of land and water resources. Loss of productive lands to urbanization and other causes and the generally wasteful usage of irrigation water in this country cannot continue even without the additional water and land needs for biomass plantations. Uncommitted sources of irrigation water including waste water can be used for energy plantations, but a new land and water conservation emphasis will be required if biomass is to be a significant factor for future energy supplies. **WTT**



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GREENBELT SURROUNDS HUGE CANADIAN STEELMAKING PLANT

By Robert Dyment, Dunkirk, NY

The most significant new development in the history of Canada's steel industry was officially completed on September 16, 1980, with the opening of one of the world's most advanced integrated steelmaking facilities. But this event occurred after years of site studies and tests on how to protect the environment were first made by Stelco Inc. for its new Lake Erie Works at Nanticoke, Ontario.

Stelco's Lake Erie Works is a "greenfield" steelmaking plant—one started from scratch—on the north shore of the lake, and also the largest single venture ever undertaken by a Canadian steelmaker. Total cost of the first stage alone was $829 million which included $94 million for environmental projects when construction started at the 6,600-acre site in 1974.

At Stelco, which is headquartered in Toronto, company officials used more than instinct to ensure that they were right with their Lake Erie development. As far back as 1962, they knew the projected demand pattern for steel to the year 2000. They also knew what production facilities they would require to fill the demand.

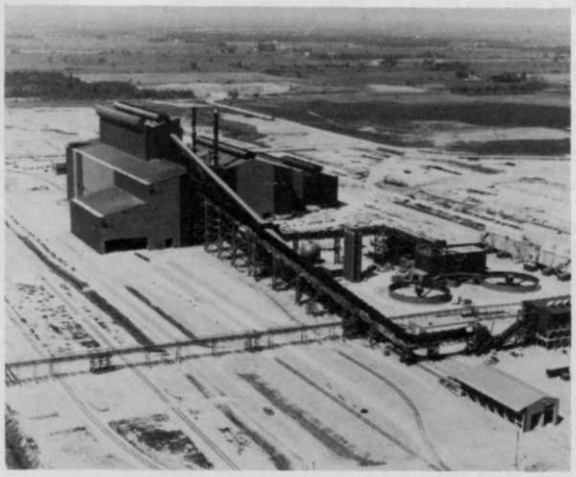
They analyzed the projected output of steel-using industries and where in Canada the greatest demand for steel was likely to be. This data determined the location for such a massive industrial complex, which has a projected annual capacity of 6 million tons.

And, even though at the outset they planned Stelco's Lake Erie Works as a greenfield project, they commissioned a further 45 studies prior to the start up of construction in order to ensure the minimum disturbance to the environment.

They studied Nanticoke's historical background, the atmospheric inventory, erosion, fisheries, historical ecology, land-use, wildlife resources, social needs, and the Lake Erie shoreline.

They planted 100,000 trees and created artificial hills and ponds. They undertook extended research in order that Stelco designers would build the most technologically advanced, cost-efficient, and cleanest steelmaking operation in the world.

Site studies prior to construction and plans to build a greenbelt around the facility played important roles in developing Canada's newest steel plant. This building is the basic oxygen furnace and slab caster complex at the Lake Erie Works.



A "greenfield" project means a company starts from scratch on a plot of land. In the United States, nearly all of the major steel plant expansions have been "brownfield," that is, expanding on site. A greenfield project is more expensive because the company has to put in the sewers, roads, utilities, and other basic structures before even constructing the plant.

But it has the advantage in that a project can be laid out for greater efficiency. Stelco, realizing it was entering a rural area, tried to make the plant less offensive to nearby residents by surrounding the complex with a greenbelt of trees, ponds, and hills. This greenbelt obstructs much of the facility's view from the roads.

Once the decision in favor of the Nanticoke site was taken, the process of land acquisition began and by 1968 Stelco had assembled 6,600 acres. Almost at once, work began on layouts for a fully integrated steel plant. This resulted in 3,600 acres of the property being set aside for steel mill development, approximately 2,400 acres being set aside for an industrial park, and the balance of the acreage being allotted to recreational and environmental purposes.

It was decided to develop a broad greenbelt to surround the steelmaking operation, separating it from the neighboring countryside. The first excavations helped to provide the material for developing a series of berms, or man-made hills, virtually concealing the plant from adjacent roads and minimizing the windborne spread of dust from raw materials.

Employees drive directly to their place of work—first, because the plant is so spread out that walking is totally impractical, and second, because acres of ugly parking lots at the plant entrance were never built.

From the very beginning, Stelco has taken a "total ecological approach" to the building of its Lake Erie Works. This concern for the environment goes far beyond the mere consideration of the effect of emissions from the plant.

Virtually every aspect of the development of the site has been undertaken with a view to its impact on the environment. In addition to the development and preservation of a landscaped greenbelt around the perimeter of the steelmaking site and the planting of thousands of trees and bushes at various locations, many existing woodlots and natural open space and watercourse areas were preserved and the latest in air and water quality control technology in the major operating plants were included.

But some of these activities were not so noticeable, and related to some of the unique features of the property. For instance, throughout the industrial park site along the north side of Stelco's property are several former farm woodlots that have been preserved in their natural state. In the midst of these, particular concern has been paid to ensure that the meeting grounds for a flock of great blue heron would not be disturbed.

Plans for a rail route through the north section of the

property took into account the preservation of a location frequented by a colony of Hungarian partridge. Extensive changes were made to the raw materials receiving dock, so that the existing sandy shoreline of Lake Erie would be maintained and fish swimming patterns along the shore could continue. The dock had originally been designed as a solid causeway, but was changed to allow a bridge section out from the shore.

All of these considerations, large and small, add up to the essence of this total ecological approach. This massive industrial development attempts, as much as possible, to blend into and co-exist with the surrounding topography. It has meant spending about $94 million on environmental projects and equipment at the Lake Erie Works—more than 10 percent of the total construction cost for Stage One.

In addition to the 45 studies undertaken to assess the environmental impact of the impending development, there were separate studies of such matters as Lake

This century-old house is located in the middle of the greenbelt area along the east side of the steelmaking property at the Lake Erie Works. Stelco restored it as part of its environmental program.

Erie water temperatures and movement, its quality and chemistry, weed bed locations, fish migration and growth, plankton and bottom fauna, and observation of ice cover.

The greenbelt project affects a half-mile-wide slice of land along the east side of the property, plus a wide section between the lake and the steel site. The contoured mounds were formed by earthmovers and then planted with grasses, bushes, and trees to form a visual screen as well as a noise buffer and a barrier to reduce the effect of winds. On the east side, the greenbelt was interspersed with small settling ponds to capture surface run-off water before it reaches Nanticoke Creek.

An elegant and stately, century-old, country house is the crowning jewel in Stelco's showpiece greenbelt. The 15-room home, the original portion of which was built in 1870, is located immediately east of the steelmaking site, smack in the middle of the greenbelt along the west side of Nanticoke Creek.

As part of the company's overall environmental policy of preserving much of the scenic landscape at the site, the old house was refurbished to its 19th Century style and the surrounding grounds were groomed and preserved to enhance the property.

The property was part of the 6,600 acres of land purchased by Stelco for its industrial development. The restoration of the home was undertaken with the guid-

Continues on page 65

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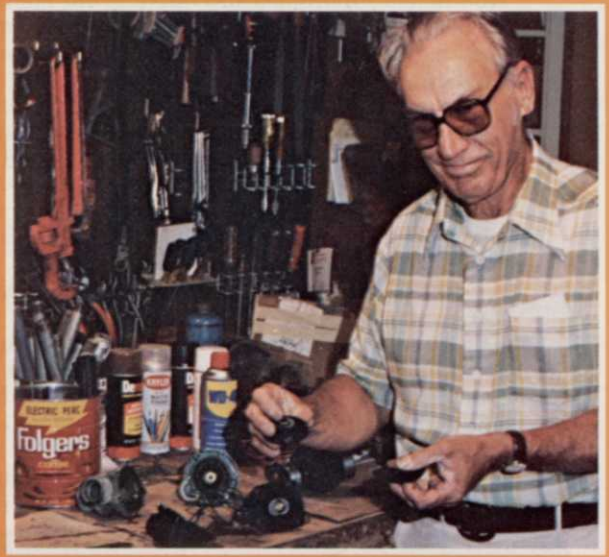

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Viburnums, Part II

NON-NATIVE VIBURNUMS THRIVE IN WELL-DRAINED, SANDY LOAMS

By Douglas Chapman, Horticulturist, Dow Gardens, Midland, MI

Non-native Viburnums also thrive in our landscapes. In fact, several of these non-native Viburnums are used more than our natives. The most important and exciting of the imported Viburnums include *Viburnum carlesii, V. X burkwoodii, V. opulus, V. plicatum tomentosum, V. rhytidophyllum,* and *V. sargentii.* All of these imports essentially thrive in fertile, well-drained soil. In fact, the key to growing many Viburnums is a well-drained, sandy loam soil. They will all adapt to a wide range of pH, but the optimal pH is 6.0.

Koreanspice Viburnum *(V. carlesii)* is a native of Korea. It is a rounded shrub, reaching 4 to 5 feet in height and width. The habit is somewhat stiff, upward spreading, and it has a rather coarse texture. Its rate of growth is slow. Koreanspice Viburnum should be considered a small specimen shrub. It is one of the earliest to flower, flowering in late April or early May in central Michigan. The buds are good, dark pink, opening to a 2 to 3 inch diameter white flower. The flowers reach their peak when the leaves are about one-half expanded or about a week after *V. X burkwoodii* flowers. Koreanspice is extremely fragrant and a tremendous understory specimen or specimen plant in intimate landscapes. The fruit matures during August and September. It grows into small, fine drupes two-fifths of an inch in diameter, with the red color changing to black at maturity. The foliage is a dull pubescent green throughout the summer, becoming red to maroon in the fall. Often, single branches will develop fall color and not the entire plant. Further, fall foliage color development is not dependable in Central Michigan. *V. carlesii* does have problems with borers and should be considered either a short-lived plant or grown only under optimal conditions.

Burkwood Viburnum *(V. X burkwoodii)* is an exciting small- to medium-sized shrub. Its shrubby habit is upright oval and multi-stemmed, reaching 8 to 9 feet in height and 5 to 7 feet in width. It grows much faster than *V. carlesii* and shows little or no borer problems. The leaves are narrow and pointed, about 1½ to 2 inches long. The summer color is a lustrous dark green with fall color remaining essentially the same. In fact, as far north as Central Michigan, *V. X burkwoodii* is semi-evergreen and, therefore, fall color is little or non-existent. When considering flowers, Burkwood Viburnum is the first of the Viburnums to flower in the spring, either in late April or early May just prior to *V. carlesii.* The bud is pink and becomes a slight pink cast when the flower is in full bloom. Burkwood Viburnum is an annual flower; the entire plant is covered with these terminally borne fragrant flowers. The fruit matures in late August, turning from red to black, with little or no ornamental value. Although diseases—crown gall, leaf spot, powdery mildew, and shoot blight—can be a problem, only the latter is a significant concern. *V. X burkwoodii* is exciting as an understory screen or mass planting for large areas or as a specimen in intimate landscapes. Its semi-evergreen characteristics give a unique texture and exciting green color throughout much of the fall—a truly outstanding plant.

European Cranberrybush Viburnum *(V. opulus)* is native to Europe and Northern Asia. The leaves are

Koreanspice Viburnum (top) is one of the earliest to flower but has problems with borers.

European Cranberrybush Viburnum (bottom) is one of the most dependable viburnums regarding fall color.

simple-toothed, 3 to 4 inches long and wide, and similar to *V. trilobum*. The summer color is a good glossy green with a dull red developing often in the fall. It must be stressed that *V. trilobum* is considerably more dependable and spectacular when judging fall color. *V. opulus*'s habit of growth is a multiple-stemmed shrub, reaching 8 to 12 feet in height and 10 to 12 feet in width with a somewhat arching, rounded habit, where as *V. trilobum* is considerably more upright. European Cranberrybush has a medium rate of growth. It is used extensively in large and small area landscapes for shrub borders, as individual specimens, or screens. The flowers are an exciting white flower in the spring, similar to *V. trilobum*, with the sterile flowers surrounding the small fertile flowers. The druping red fruit develop in September and persist throughout much of the winter. One truly outstanding cultivar is the yellow fruiting form *V. opulus* 'Xanthocarpum'.

Doublefile Viburnum *(V. plicatum tomentosum)* is a truly outstanding import, native to China and Japan. It has almost horizontal branches that surround a central stem, giving one a layered feeling, similar to the habit of *Cornus florida*. At maturity it often reaches 8 to 12 feet in height and width with the shrub being a little wider than tall. Leaves are serrated-lobed oval, 2 to 4 inches, medium in texture, and dark green throughout the summer with consistent maroon to purplish-red fall color. Fall color is so outstanding that Doublefile Viburnum should be considered the showiest of all non-native Viburnum. The flowers grow 2 to 4 inches in diameter with large white, sterile flowers surrounding small yellow fertile inner flowers. Fruit of Doublefile Viburnum matures earlier than all the Viburnum, usually during late July or early August. It ranges in color from red at bloom to black at full maturity. *V. plicatum tomentosum* prefers fertile, well-drained soil. It is outstanding as a specimen plant for large area or home landscapes. Doublefile is a good understory plant or companion with Chokecherry or deep-rooted trees. This truly regal import should be used more extensively in the landscape.

Leatherleaf Viburnum *(V. rhytidophyllum)* is a multiple-stemmed shrub 10 to 15 feet in height and 8 to 10 feet in width. The simple, opposite oval leaves reach 3 to 7 inches in length and are dark green in the summer, giving a somewhat coarse texture. Leatherleaf Viburnum is a semi-evergreen; therefore, fall color rarely develops. The yellow-white flowers which develop in mid-May reach 4 to 8 inches in diameter. The red to black ⅓-inch long fruit is not effective in the general landscape situation. Leatherleaf Viburnum is an aggressive multiple-stemmed shrub. Often in northern areas, which include northern Ohio or Michigan, it will be killed to the ground but dependably comes back from the roots. This outstanding plant is good in mass plantings, and as screens or border shrubs. It thrives in shady, protected areas and is compatible with ericaceous plantings, e.g., Rhododendrons.

Sargent Viburnum *(V. sargentii)* is native to northern Asia. This rounded, multiple-stemmed shrub reaches 12 to 15 feet in height and width and has a somewhat coarse texture. The white flowers differ from *V. opulus* in that the anthers are purple as opposed to yellow for *V. opulus*. The two-fifths-inch scarlet fruit is effective in early August. The leaf is similar to *V. opulus* yet thicker and somewhat coarser. Sargent Viburnum is certainly a specimen or works well as a screen or mass planting.

When planning to use deciduous shrubs in the landscape, Viburnums should be considered. Although the imported Viburnums are used more often, in general, any of our native Viburnums have less insect and disease problems while integrating into natural landscapes as an understory shrub or small tree. *V. trilobum* with less insect and disease problems; *V. prunifolium* with its outstanding fall color and fruit; and *V. lentago* with its exceptional summer leaf and fall color should be considered in almost any landscape. Of the non-natives, certainly Doublefile Viburnum *(V. plicatum tomentosum)* is the outstanding individual. It has a unique sympodial habit of growth, showy flowers, and outstanding fall color. Of the smaller shrubs, *V. X burkwoodii* should be considered, since it's a semi-evergreen and multiple-stemmed with extremely showy flowers. Viburnums are a must in almost any landscape from industrial to home. They are low maintenance, have few insect and disease problems, and are tolerant of many pollutants. **WTT**

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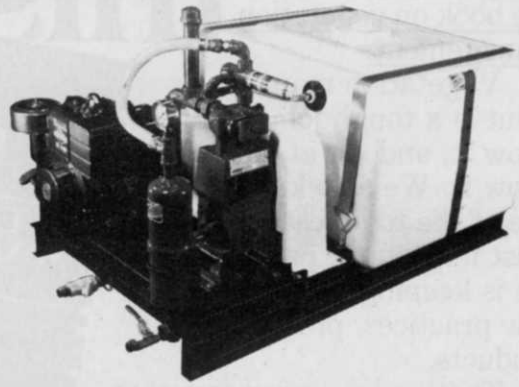

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THE EFFECT OF LOW PHOSPHORUS ON POA-ANNUA PUTTING GREENS

By Paul Voykin, Superintendent, Briarwood Country Club, Deerfield, IL

In the course of my education I have found out that nutrients may enter plants through the leaves, stems, or roots. The most natural and major way is through the roots. The soil is a storehouse for water and nutrient needs by plants. Therefore, we know that good soil management should make a constant and adequate supply of required and necessary nutrients available for growing plants. While doing my studying and my research I became very interested in one particular element — phosphorus. I found out that adequate P levels in the soil would promote fast, vigorous root growth during the seedling stages. And also if some roots were destroyed new roots would be produced so fast that little injury would be evident. Perhaps that's why the North American Indian advised the pilgrims to place a fish below each hill of corn — not on top but below where it would do the new plants the most good. The flesh gave the plant some calcium (Ca) and K, and the fish bones provided lots of P. We still use fish fertilizer but we bottle it and use it for house plants.

I also read that young plants have a high nutrient requirement relative to their size. Their nutrient content is from two to several times greater than in mature plants. Furthermore, nutrients accumulated in young plants may redistribute as the plant matures. To back these discoveries, I then read in farm magazines that P uptake was greatest for the first growth stage and decreased with plant age. This is generally true for turf, but this can be at lower rates because turf grasses need less P than high yielding grain crops and vegetables. Farmers long ago found out that sugar beets, corn, wheat, alfalfa, barley, etc., do much better when P is band applied at proper depths. If fertilizer is broadcast randomly over the soil surface it will be diluted with soil and little will be available for uptake by early developing roots. It has long been recognized that banded P application is more important than for other nutrients.

A greenkeeper puts P in the root zone when he seeds a nursery or other turf areas. How deep to apply a starter P fertilizer has never been critically determined for turf. From my experience, I think it would be just beneath the surface. P is subject to little leaching. Therefore, after the initial application, very little P may be needed to maintain adequate levels. Most superintendents for some reason do not adhere to this theory. Keep in mind that fertilizer applications were started as a supplement to that available under natural soil conditions. Therefore, I think there is a tendency to maintain too high amounts of P in mixed fertilizer goods. K, on the other hand, is leached by waterings or rainfall. Thus with heavy water, especially on sandy soils, the K moves from the root zone. Also, clipping removal causes a steady drain on nutrients, particularly N and K. So from this, and other less relevant factors, I conclude that P needs should be based on soil test. Adding more to a mature crop is wastful and does nothing more than encourage notorious shallow-rooted weeds such as chickweed, crabgrass, and poa-annua, whose seed as you know is available in large quantities at the soil surface. Maybe the whole key to this is this: where putting-green root penetration is deep, lower rates of soil P can be maintained than where roots are shallow, such as with the above-mentioned weeds whose swift germination and health is based on higher levels of phosphorus. However, if soil tests show that a green desperately needs P, which in our midwest area is not common, then the phosphorus should not be broadcast over the turf randomly, but be put down closer to the roots through slicing, spiking, and, perhaps best of all, laid down after aereating the greens. We know P will not move far from its point of placement; however, on high sand greens P may move well through the profile. Just throwing it over mature turf by broadcast methods doesn't do much to get it down into the root zone. My observation has been that most greenkeepers don't allow enough time for granular phosphorus to dissolve and it is usually picked up by the greensmower.

When I came to Briarwood twenty years ago, I found that a recent soil test indicated that phosphorus levels in my greens were extremely high and that K levels were extremely low. Twenty years later, by not using P at all except on special occasions and by using K and N only as required, I have reduced the P levels by half or more. Which is still too high. However, I have brought up the K to desirable levels. In the process I have found out that by not overfertilizing with P in concert with other good maintenance procedures, my poa population has not increased in recent years. In fact, I believe it has diminished. So now after twenty years I can boast that I have as much or more Washington creeping bent as when I first started. At that time the greens, despite high phosphorus content in the soil, were almost all bent. This was due mostly to the fact that the course was public before the Briarwood people took it over. Being a public course the greens were mowed extremely high and watered very infrequently. However, I know of three private courses in my area which, twenty years ago, had beautiful creeping bent; but the "new" supts. who took charge of them overwatered their fine turf, overloaded them with P on poorly drained soil that wasn't exactly good sandy loam and now are devastated with poa-annua on their greens. In fact, one of them is seriously thinking of resodding all the green surfaces with fresh creeping bent and hauling the poa-annua away. But what is the use of this enormous expense if his practices are going to remain the same? He comes to my place and says, "Boy you sure have lots of bent. You're lucky!"

Recently Roy Goss, extension agronomist at the Western Washington Research Extension Center, wrote: "Phosphorus applications significantly increased poa-annua in all our plots in our tests, which suggests that rates of phosphorus possibly as high as those used (4 pounds per 1,000 square feet P_2O_5) or higher may be required for normal bluegrass development. It should be pointed out, however, that most golf course superintendents and other turfgrass managers have in my view consistently overapplied phosphorus. In nearly all cases in the Pacific Northwest, putting green soil tests reveal extremely high phosphorus levels.

Thomas W. Cook, now at Oregon State University,

wrote: "As you have undoubtedly heard before, one of the most commonly abused management tools is the fertilizer program. In attempting to control poa-annua it is important to keep phosphorus and nitrogen levels moderate. Excessive nitrogen and phosphorus and disregard to proper balance of nutrients has helped to make the poa-annua a problem much worse than it should be."

In 1978, Dr. Al Turgeon showed at the U. of Ill. field day that fertilizer containing phosphorus resulted in better poa-annua turf plots than where straight N was used. He also pointed out that P deficiencies rarely are observed in established turf unless the P level in the soil is extremely low.

A research report compiled by the team of Drs. Beard, Turgeon, Riehe, and Vargas prescribed a cultural program for annual bluegrass greens, under the heading "Fertilization Phosphorus." They stated the application rate should be based on soil test using a program that maintains a moderately high level of soil phosphorous. Applications are best made in the spring or fall. Well, how much proof do you need that we are throwing away good money and good creeping bent greens by using phosphorous? I would like to see the fertilizer manufacturers put a big skull and crossbones on each bag of fertilizer containing phosphorus "poison" in the same manner the druggist once did with medicine bottles.

But let me say again to you that just putting down less or no phosphorus is not going to keep the poa out entirely. It's just one of the more important tools in the overall maintenance program that a good supt. works into the picture. I carry out other cultural practices that I believe diminish the encroachment and germination of poa-annua. They are as follows:

1. If I have to use a little fertilizer containing P (such as activated sewerage sludge), I do it only in the hot temperatures when poa isn't germinating well. I am talking about the latter part of June until the second week in August. I believe that in hot weather P applied on mostly organic sandy soils is utilized or tied up by the time climate conditions are again beneficial for poa-annua germination.
2. I aerify and topdress only in the fall. The popular statement by some experts that poa-annua comes in the fall in the aerifying holes in our area is not always true as far as my observations are concerned. Two hundred miles south it might be a desired situation but I am making an observation about my area only. Of course, if you have nothing but poa on your greens, then what do you expect? A miracle encroachment of bent grass? That will hardly be the case. But I'll give you a little secret. Throw some creeping bent seed into the topdressed holes wherever the grass is weak, wherever the riding mowers turn, or over the whole green if its mostly poa-annua. I sometimes get very good germination. If your other cultural practices, such as fertilizing, watering, topdressing, seeding, and spraying, are done with common sense you aren't going to get any more poa infestation than you would in the summer. But I caution young supts. in our area to watch out for spring aerifying when poa is germinating.
3. Twice or more during the summer I reseed all ballmarks on the greens. This practice also adds fresh bent to our greens.
4. I try to use the proper fungicides in the summer. Fungicides mixed in plenty of water won't shock the grass if they are applied per label. Into my fungicide solutions, I always throw in a little soluble nitrogen — never any other fertilizer. This method keeps the greens in good color but with no appreciable growth to cause a poor putting surface.
5. For many years I used lead arsenate in my last fall and my first spring fungicidal program. Arsenics are taken through the plants roots in a similar manner to that of P. Arsenic and phosphorus are difficult to separate and since the plant needs the P this causes problems, especially for young plants. When the arsenic level is fairly high compared to P in the soil, the poa-annua and other plants will take up arsenic to cause trouble.

C. W. Lobenstein has noted poa control success depends upon very careful control of the arsenic and phosphate levels in the top layer of the rootzone so that the weedy species absorb toxic quantities of arsenic in the place of phosphate while the desired turf species escape injury. The use of phosphate fertilizers preceding or soon after arsenate application must be discouraged. He then goes on to conclude that an arsenical program ought to be even more effective on soils of low phosphate content. It should be noted that research has demonstrated that arsenic applications on soils low in available P has caused serious damage to Kentucky bluegrass turf.

Last, and perhaps most important of all, I use good watering practices. In my opinion, I use less than anyone else in my area. Carl Swartzkoph puts it this way: "As a result of using minimal amounts of water at Briarwood, additional physiological stress has been experienced by the poa-annua, thereby giving the more desirable and permanent grasses a chance to become established on greens and fairways."

Maybe along with all this I also have been fortunate in having had good superintendent friends to advise me, to show me their errors and their secrets and their golf courses in stress times and good times. Plus a lot of commercial people who were helpful with their fertilizer information. Plus a few wonderful outstanding agronomy professors from major universities who have been available whenever I had a question or a big problem. And, of course, my friends in the USGA have been very helpful. So twenty years later, every time I look at my creeping Washington bent in the month of the "falling yellow," when old lonely October turns them dark purple, I realize with pride that I still have 90 percent (or better) creeping bent greens. I know in my mind that I have done the right thing and I know in my heart that *I have been lucky.* **WTT**

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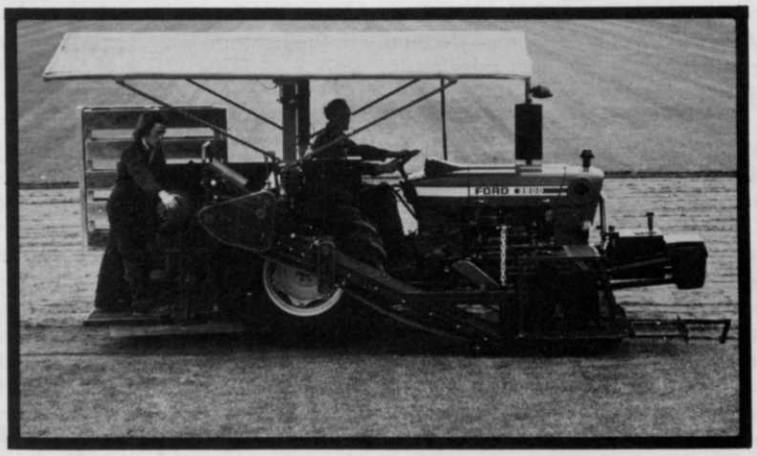

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WHITE-BARKED BIRCHES, BORERS AND ALTERNATIVES

by Michael A. Dirr., Director University of Georgia Botanical Garden, Athens, GA.

When I worked at a garden center during my undergraduate days at Ohio State, it was a standard joke to bet whether the customer could get his white-barked (usually *Betula pendula)* birch home and in the ground before the borers found it. Sometimes I think the borers found the tree before it ever arrived at the garden center. Whatever the case, little has changed for the old-standard, borer-susceptible white birch. Some nurserymen have started to grow other white-barked birches that supposedly offer bronze-birch borer resistance. Before we progress too far, let's eliminate *B. pendula,* European white birch, and *B. populifolia,* grey birch, from consideration. Although grey birch is somewhat resistant to the borer, it suffers terribly from leaf miner and is short-lived—not exactly endearing traits for a landscape specimen.

Growing up in Cincinnati, Ohio, matriculating at Ohio State and the University of Massachusetts, and serving as a faculty member for seven years at the University of Illinois allowed me the opportunity to view white-barked birches in many states of disrepair. I will never forget a European white birch (dead) in one gentleman's yard that had the branches cut back to within two feet of the main trunk with a morning glory trained on the trunk. Looked great in summer but left a visual blight in winter.

In Champaign-Urbana, IL, virtually every yard had one white-barked birch, sometimes a grove. I had one in my yard that I planned to cut down, much to the dismay of my wife. Unfortunately, the tree was ravaged by the borer before I could afford a chain saw. In fact, I observed trees dying all over the Midwest. I would present the case of the borer-infested birch to my students who soon realized that there was one in their parent's yard.

The question that came up was "What are the alternatives?" I remember Dr. Ed Hasselkus showing me a group of three, white-barked birch trees at the University of Wisconsin Arboretum. He commented that these lived while *Betula pendula* and cultivars were exterminated by the borer. Their name: *B. platphylla* var. *japonica.* More on this later.

Next on the scene was a mystery birch termed *B. maximowicziana,* monarch birch. Articles appeared in popular and trade magazines. Nurseries started to sell it. It was touted as the savior of ornamental white-barked birches. There was one problem with all this: the birch being promoted and sold was not monarch. I had seen plants of so-called monarch at the Holden and Dawes Arboretum in Ohio and they had good white bark and leaves that looked like *B. papyrifera.* Unfortunately, people failed to check the taxonomic descriptions of *B. maximowicziana.* Had this been done I doubt if the confusion would have developed. Drs. Frank Santamour and Frederick Meyer resolved some of the taxonomic confusion concerning the species (see *American Nurseryman* 145(12):7. True monarch birch has large leaves (up to six inches) with deeply cordate bases, large female catkins, and grayish to orangish brown bark.

Birch borers took their toll on *Betula pendula* (insert) but have not succeeded in defoliating a *Betula nigra* 'Heritage'.

At about the same time (1976-78) two additional white-barked, borer-free birches appeared on the scene. *Betula platyphylla* var. *japonica* (formerly *B. mandshurica* var. *japonica)* and *B. p.* var. *szechuanica* (formerly *B. mandshurica* var. *szechuanica)* appeared to have possibilities for general landscape use. Variety *japonica* is more refined and more reminiscent of *B. pendula.* Variety *szechuanica* has stouter stems and more leathery, wavy leaves; their underside densely glandular dotted. Dr. Frank Santamour and Dr. Knud Clausen described the testing with *B. p.* var. *japonica* that is being conducted at the National Arboretum (see *American Nurseryman* 149(1):15).

Tom Pinney, Jr., Evergreen Nursery Co., Sturgeon Bay, Wisconsin has been as close to the subject as anyone in the country and may be the only nurseryman who has the true monarch birch. He noted that reports of borer infestations on both varieties, *japonica* and *szechuanica,* have surfaced. However, there have been no reported borer infestation on plants grown from the University of Wisconsin Arboretum seed source. An interesting aside was his comment relative to the excellent performance of *B. papyrifera.* In Min-

Continues on page 54

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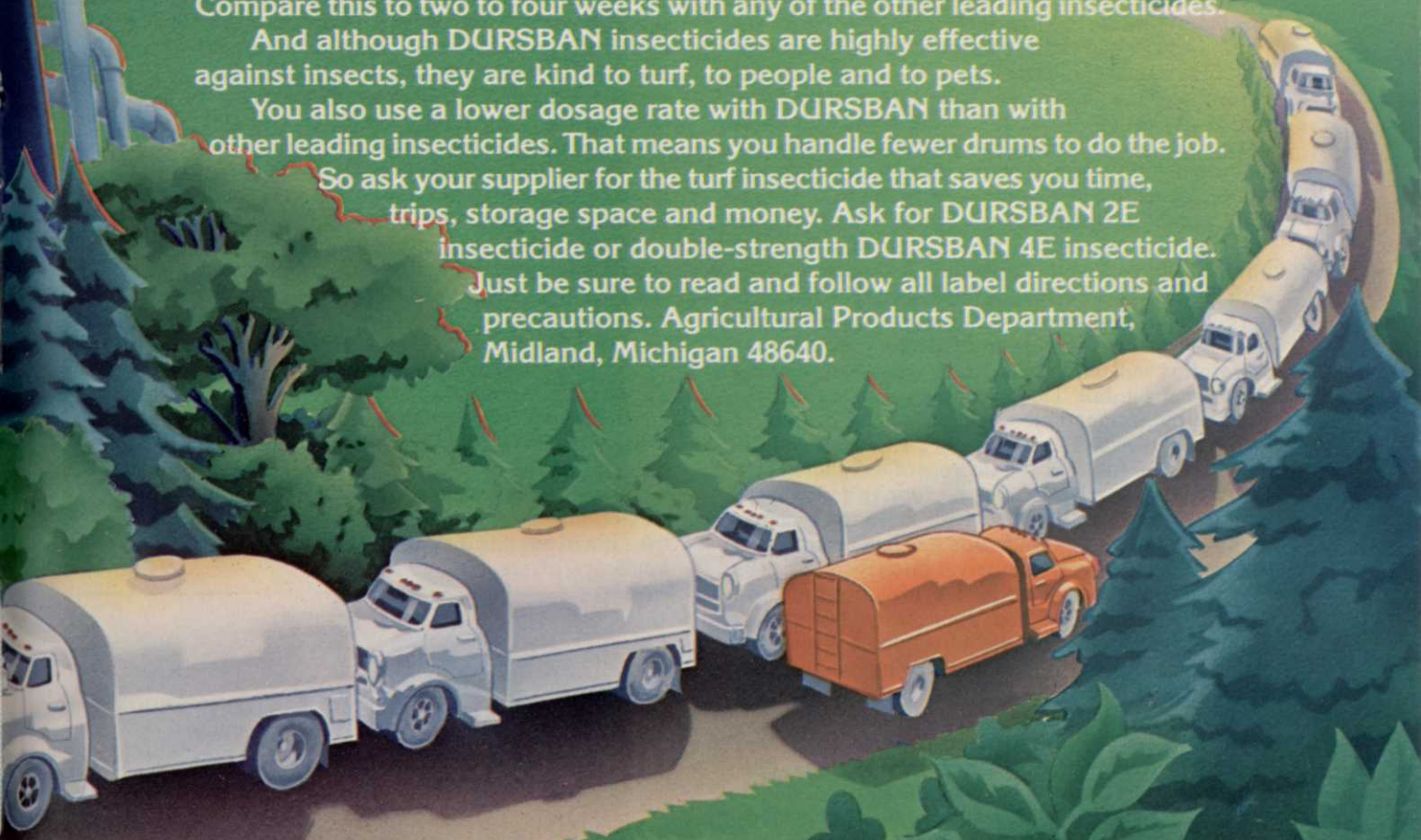

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Birches *from page 51*

nesota (Landscape Arboretum) tests, only one tree out of 104 *B. papyrifera* was borer infested. Although this tree has been maligned for years, I wonder if it should not be given a long second look. It is certainly one of the handsomest of all white-barked species. I would also like to raise the question whether all the *B. papyrifera* that were described in the past as borer infested were, in fact, the *true* species. Birch identification is fraught with difficulty and monarch exemplifies the problem.

The search for the illusive, borer-free, white-barked birch continues but why not back up a step and consider a native species, as a possible alternative. The river birch, *Betula nigra*, has many significant advantages over the white-barked species. One is the resistance to bronze birch borer; the other relates to the excellent heat and cold tolerance. Dr. Harold Pellett, University of Minnesota Landscape Arboretum, and the author have been testing the cold hardiness of plants that have extended North/South distributions. In laboratory test, river birch collected from the wild near Athens, Georgia, proved as cold hardy as plants collected from Minnesota sources. In fact, young stems from both sources were not injured when exposed to temperatures of -50°F. In addition, river birch can withstand flooding for long periods of time.

River birch is native to areas along streams and rivers from southern Minnesota south to Northern Florida and from Delaware west to Kansas. I have seen beautiful stands along the Illinois river and along the banks and flood plain of the Oconee River in the UGA Botanical Garden. It occurs in association with hackberry, American sycamore, boxelder, sweetgum, green ash, tulip-tree, red maple, American hornbeam, water oak, willow and cottonwood in the UGA Botanical Garden floodplain.

It is interesting to note that in upland sites, river birch is seldom found. Apparently it cannot compete with the oak, hickory, maple, and beech. The reason is not related to soil moisture alone because landscape specimens on the Illinois and Georgia campuses are performing well on sites that never witnessed anything but normal rainfall. The most obvious aspect of river birch is the tremendous variation among progeny. I walk along the river trail in the UGA Garden and see barks of different hues and degrees of exfoliation.

River birch, as a landscape tree, forms a graceful pyramidal to oval outline that with maturity becomes rounded. The average landscape size ranges from 40 to 60 feet with the largest living river birch recorded at 80 feet high and 90 feet wide. I prefer the multiple stemmed or low-branched appearance but single-stemmed specimens are also effective. A few of the places I have observed the species being used in landscape situations include planters, court yards, front yards, groupings and screens.

The foliage is lustrous dark green above, gray-green beneath, and triangular to diamond shaped in outline. Leafspot can be a significant problem in wet weather. Fall color is seldom good; in fact, I can never remember, observing excellent fall color on the species. The trees in the UGA Garden dropped green or yellow-green.

The bark of river birch is fantastic, varies from gray-brown to cinnamon-brown, and exfoliates in papery curls and flakes. This exfoliating character develops on branches above one inch in diameter. The leafless branches of river birch framed against a winter sky are a gorgeous sight. The young branches are a rich red-brown and grade to the exfoliating character that becomes more pronounced toward the center of the tree. Large diameter branches become more ridged-and-furrowed and do not show the exfoliation. I much prefer the more subtle bark characteristics of river birch over the obtrusive white-barked species. As mentioned, there is tremendous variation in bark color and one enterprising nurseryman has selected a superior form that exhibits almost white bark. The first named cultivar of river birch has been called 'Heritage' and may, with time, supersede the white-barked birches in the landscape trades. The bark actually varies from white to a bloomy salmon pink and is striking in the winter landscape. The leaves are about 1½ to 2 times as large as the species and are more resistant to leaf spot. It also displays excellent bronze birch borer resistance. I have seen large plants of 'Heritage' and would label it a "can't miss" landscape plant of the future. Several nursery firms are offering it as rooted cuttings.

River birch sheds its seed in spring which is opposite that of most birches. In late spring, the high water is receding and silty shore lines are exposed which offer the best possible place for the wind-blown or water-borne seeds to germinate. It is best transplanted in spring and prefers a moist, *acid* soil for best growth. In alkaline soils, chlorosis can be a problem. During the extreme drought of 1980, trees in landscape settings dropped many leaves. Supplemental watering is necessary under these conditions. If properly watered and fertilized, river birch will easily make three feet of growth per year. I see no reason why it could not be handled as a container plant.

Cuttings can successfully be rooted under mist. They should be taken during June and July, treated with a hormone (we have used 1000ppm IBA/alcohol; quick dip), and placed in a suitable medium under mist. Seeds can be sown in the spring as soon as they are collected. Due to the light sensitive nature of birch seed, it should be barely covered or sown uncovered and kept moist. Percent germination is usually low.

River birch is a great tree and many authorities have often raised the question relative to its scarcity in the landscape. As plantsmen, nurserymen, landscape architects and homeowners become more aware of this tree, it will assume a rightful place in the forefront of landscape plants. **WTT**

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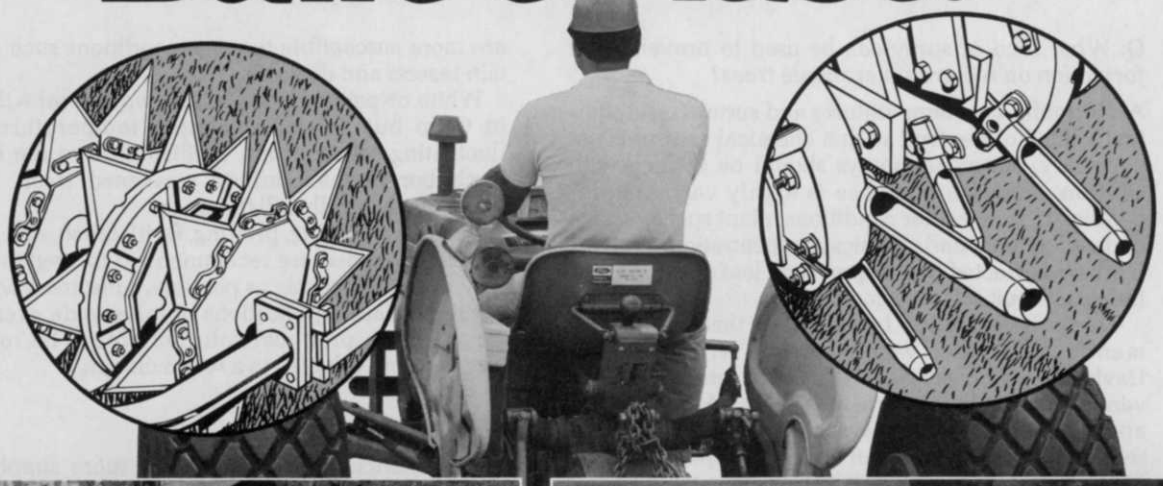

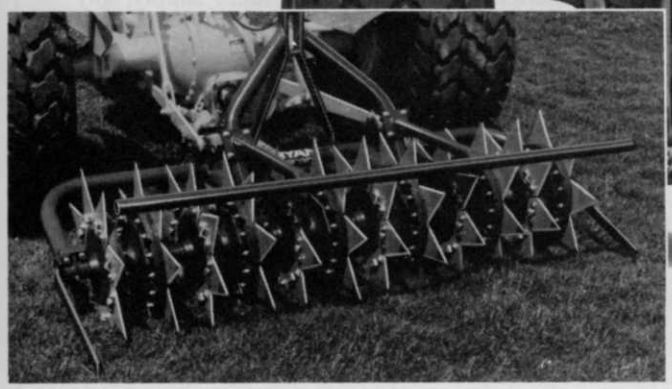

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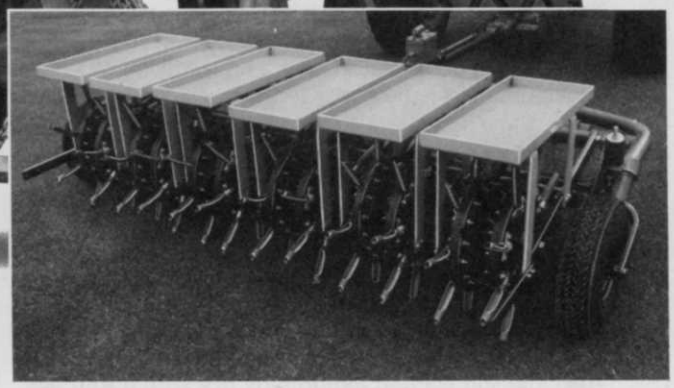

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VEGETATION MANAGEMENT

By Roger Funk, Ph.D., Davey Tree Expert Co., Kent, Ohio

Q: *What kind of spray can be used to prevent seed formation on mature silver maple trees?*

A: Normally, cool temperatures and spring frosts eliminate much of the fruit so that chemical control is not necessary. Hormonal sprays should be applied with caution since the response is highly variable, depending upon weather conditions, plant species, stage of development, and chemical concentration. Fruit set is often unaffected by the spray, and leaf distortion and increased fruit set are common.

The only reference I could find that specifically mentioned maples was an article written by Dr. Davidson (Michigan State) in 1972, entitled, "Preventing Fruiting of Ornamental Trees." His suggested application for maples was naphthyleneacetic acid (NAA) at a concentration of 40-60 ppm sprayed at full bloom. The results were listed as poor to fair. You should check with your local extension agent to see if NAA, or any other materials, are presently labelled for prevention of seeds on maples.

Q: *How can you tell if a gas leak caused a tree to die?*

A: Assuming you are referring to a natural gas line, call the gas company and have the area checked for a leak.

Damage usually occurs in a circle radiating out from the source of the leak with the most serious injury occurring over the leak. If the tree is planted in a lawn, the turfgrasses will turn brown in the affected area. Also, the soil is often abnormally dry with a sour gas smell and the roots an abnormally dark color.

Q: *Several of our golf course fairways are lined with Australian pine trees. The shallow root system of the pines prevents the establishment of good Bermuda turf in these areas. Can Australian pines be root pruned without causing damage to the trees themselves? If so, what equipment do you recommend for this pruning? (Orlando, Florida)*

A: Australian pine *(Casuarina equisetifolia)*, also called Beefwood, is a vigorous grower and should not be injured if root pruned properly.

Starting at the dripline (the outermost tip of the branches), measure the distance to the trunk. Root pruning cuts should not be made closer to the trunk than one half the total distance from the trunk to the dripline. As a precautionary measure, you may want to root prune a few trees and observe the effects over one season.

A hydraulic spade such as used in digging trees should easily cut the roots while causing minimum disruption to turf.

Q: *Why are white birches so hard to grow? (Ohio)*

A: Every plant has a climatic zone of adaptation within which it grows. At the northernmost and southernmost limits of this zone, plants do not grow vigorously and are more susceptible to stress conditions such as certain insects and diseases.

White or paper birch *(Betula papyrifera)* will grow in Ohio but the warm-season temperatures and fluctuating soil moisture predispose it to the bronze birch borer which infests weakened trees. Heavy infestations usually kill the trees.

Vertical mulching, pruning, fertilization, and watering when needed are recommended to keep the trees growing as vigorously as possible. Most trees will also require several applications of insecticide every season. A more practical solution would be to plant birches more adapted to a warm climate.

Q: *What is an acaricide?*

A: An acaricide is a miticide, or more simply, any chemical used to kill mites.

Q. *How can I get rid of crowfoot in bentgrass? This is a problem on all golf courses in this area and it gets worse each year. (North Carolina)*

A: The extension service in your area has told us that crowfoot is a common name for goosegrass *(Eleusine indica)*, although it may be confused with other coarse-bladed grasses. Goosegrass is an annual grass with a prostrate, star-shaped growth pattern and distinctive seedhead. It can be controlled with pre-emergent herbicides such as bensulide applied in early May or before the soil temperature stabilizes above 75°F.

Q: *We have been searching for a growth regulator to be used on Bermuda 419 turf around sand traps. We have been looking at Atrinal, by Maag Agrochemicals Marketing, but cannot find any information concerning turfs. Do you know of any growth regulators that will work on turfs?*

A: At the present time, Atrinal is not labeled for turf and the cost is not competitive with mowing.

The most commonly used chemicals for turf growth retardation have been maleic hydrazide (MH-30, Retard) and chlorflurenol (Maintain CF-125). In 1978, Embark 2-S (Mefluidide) was introduced and has shown favorable results on common Bermudagrass. Although Embark 2-S appears to have overcome some of the serious disadvantages of maleic hydrazide and chloroflurenol, all growth retardants slow turf recovery from environmental and other stresses.

I would suggest that you test one or more of the products to determine how they perform under your conditions. The basic producers are:

Maleic hydrazide — Uniroyal Chemical
Chloroflurenol — U.S. Borax
Mefluidide — 3M Company

Send your questions or comments to: Vegetation Management c/o WEEDS TREES & TURF, 757 Third Avenue, New York, NY 10017. Leave at least two months for Roger Funk's response in this column.

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News *from page 16*

contribution to the environment through a Sesquicentennial Project. The citizens of Marshall had planted more than 16 new trees and created a self-guiding "Tree Tour" to help celebrate the city's 150th birthday.

Les Bork, Jr., governor of the Illinois chapter, gave the other award to Carriage Hill of Glenville, Illinois, for an outstanding use of living plants in its renovation of a 125-unit condominium. Flowers, shrubs, and trees for shaded walkways had been planted to give a new look to Carriage Hill.

The award, a beautifully engraved walnut plaque, is designed for individuals, companies, governmental agencies, churches, clubs, and communities which use the green gifts of nature in publicly accessible locations.

ASSOCIATION

Power equipment distributors organize

The Outdoor Power Equipment Distributors Association was recently formed by leaders of the billion-dollar industry at the GIA Show in Baltimore, Maryland. Officers and directors of the new association were elected.

Joe H. Brady, Jr., of Joe H. Brady & Associates, Inc., Birmingham, Alabama, was elected president; Wyn Eaton of Eaton Equipment Corporation, Hamburg, New York, was named vice president; Bill Niemeyer of the Niemeyer Corporation, West Chester, Pennsylvania, became secretary; and Joe Porter of Porter Brothers, Inc., Shelby, North Carolina, was voted treasurer.

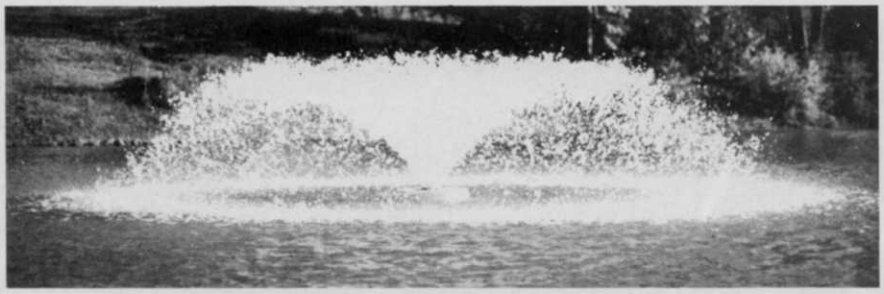
The firm of Fernley & Fernley, Inc., has been retained to provide management services for OPEDA. The Fernley & Fernley offices, at 1900 Arch Street, Philadelphia, Pennsylvania, will serve as association headquarters.

PLANT CONTROL

Meeting held on aquatic plant control

The 15th annual meeting of the Aquatic Plant Control Research Planning and

Continues on page 71



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Operations Review was held November 17-20, 1980, at the Sheraton-Savannah Inn in Savannah, Georgia. Approximately 140 engineers and scientists attended.

Reports on aquatic plant problems were presented by various district representatives, and talks were given by specialists in all areas: biological, mechanical, and chemical control.

William N. Rushing of the Waterways Experiment Station in Vicksburg, Mississippi, said, "It was one of the finest meetings we have had because of the caliber of the papers presented and the interest shown by the people there."

CONFERENCE

Expanded turf show draws 1,200 in Jersey

More than 1,200 people attended the New Jersey Turfgrass Expo '80, which commemorated the 10th anniversary of the New Jersey Turfgrass Association.

The conference, held at the Cherry Hill Hyatt House, presented a diversity of programs on turf and received numerous favorable comments on the speaker-topic selection, according to Dr. Henry Indyk, general chairman.

The first day's topics related to insect and weed control; the second day was divided into special sessions on golf and fine turf and lawn and utility turf; and the third day focused on lawns and sod. The golf sessions focused on the needs of bentgrass and control of annual bluegrass. A lively discussion occurred in the utility turf session concerning athletic fields, which also included baseball field care.

GROUNDS

Members of grounds society share ideas

An innovation at the Annual Conference of the Professional Grounds Management Society was a "Brag Night," in which members had a chance to give impromptu 15 to 20-minute talks and slide presentations about their accomplishments.

Attendance at the Conference was better than usual, with about 150 people present, according to Allan Shulder, executive director.

The Society elected new officers for 1981. John Van Vorst, who served last year as president-elect, was automati-

Continues on page 71

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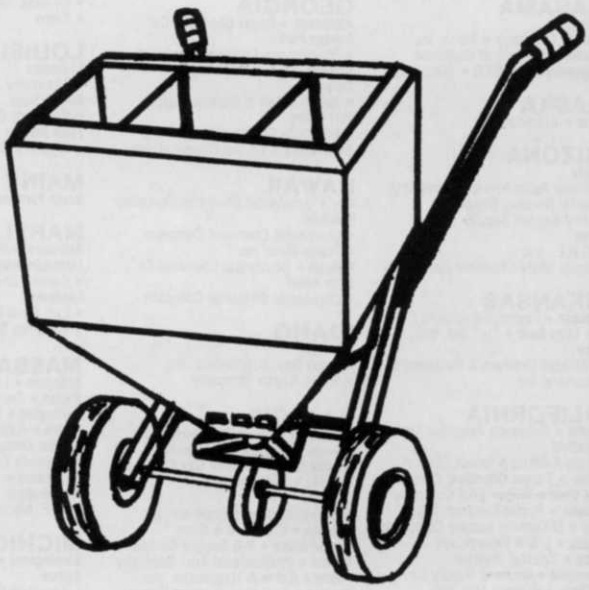

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SOD PRODUCER NEWS

Warren's Turf Nursery acquired by Curran

The Curran interests of Crystal Lake, Illinois, have acquired ownership of Warren's Turf Nursery, Inc., headquartered at Palos Hills, a Chicago suburb, through transfer of stock certificates.

The Warren firm has nearly 5,000 acres of land under cultivation and is one of the largest growers of sod in the world. Currently, it is developing European and Asiatic, Australian and African markets for its patented grasses.

Warren's is the only turf grower with a research department that has led to the development of improved lawn grasses. The A-34 was the only one rated excellent by Michigan State University for wear tolerance, a quality which makes it particularly suitable for athletic fields and sports grounds. The A-20 is noted for its deep green color and disease resistance.

Besides new grasses, the firm's contribution to the turf industry includes turf handling equipment such as sod cutters, sod harvesters, and sod washing machines for the removal of soil from newly harvested sod. Soil removal results in a much lighter product, allowing lighter pay loads, and it enables newly planted turf to knit to the site soil more quickly.

Another innovation of Warren's is the vacuum cooling of sod on hot days. The cooling system lowers the temperature of newly harvested sod to just above freezing within about thirty minutes. The company has also pioneered in the dehydration and preservation of bluegrass clippings for poultry and livestock feed.

The Curran people who have acquired Warren's Turf Nurseries are diversified, with interests in paving, trucking, and railroad equipment. They have indicated that the management of the Warren organization will continue under the direction of the Warren brothers.

GREENBELT *from page 43*

ance of Professor Eric Arthur of Toronto, a noted architect and historian, who verified the authenticity of the 1870 construction date. The home is the focal point of the company's community relations program at the Lake Erie Works.

Stelco has already planted well over 100,000 trees and shrubs within their greenbelt system and these will be supplemented by many more, including 6,000 flowering varieties currently being grown at their on-site nursery. This nursery, incidentally, is located next to the old home that was restored.

The entire steelmaking development is surrounded by a greenbelt, which in places extends up to half a mile in width. The series of earth mounds, some up to thirty feet high, are but a few examples of the careful planning and millions of dollars spent on a greenbelt to make this one of the most environmentally attractive new steel plants on the North American continent. **WTT**

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The Land Reclamation Report

Part of strip-mining law unconstitutional

A federal judge has ruled that parts of a 1977 federal law requiring coal-mine operators to restore strip-mined farmland to original condition are unconstitutional.

Judge James E. Noland in Indianapolis, IN, ruled that the law requiring coal-mine operators to identify prime farmland and its average crop yields, to remove and replace soil layers separately, and to restore the farmland to its previous fertility level violated the Tenth Amendment to the Constitution. The Tenth Amendment reserves to the states and individuals those powers that aren't specifically granted to the federal government.

The judge also struck down provisions requiring the Interior Department to determine that the coal-mine operator "has the technological capability" to restore the land and requiring the department to approve a use for the land after it has been mined.

Coal use leaps but industry still hurts

The U.S. used more coal in 1980 than originally predicted, but widespread unemployment and unused capacity still plague the industry, reports Newhouse news service.

Consumption of U.S. coal, both domestically and for export, was expected to grow to about 799 million tons in 1980, an increase of almost eight percent over 1979.

Greater use of coal by the nation's utilities and a booming export market accounted for the increased demand.

"Utilities, which account for over 70 percent of demand, are running existing coal-fired plants at higher capacity and are making use of new facilities," says Carl Bagge, president of the National Coal Association.

Bagge said 25 new coal-fired power plants were added in 1979 and another 30 were anticipated in 1980. In addition, a number of utilities, mainly in the East, are reducing their use of oil-fired power plants and are buying energy from coal-burning plants in the Midwest.

Two large projects planned for Midwest

The Office of Surface Mining will reclaim 15 abandoned coal mine sites in Pennsylvania at a cost of $6.6 million and 89 acres of abandoned coal mine lands in the Wayne National Forest in Ohio at $1 million.

The Pennsylvania projects range in size from $2.4 million to correct a massive subsidence problem in Scranton to a pair of $14,000 projects to fill open mine shafts which threaten the safety of children in the Boroughs of Kingston and Duryea in Luzerne County. Eight of the 15 projects lie in the anthracite country.

The Ohio project, located about 50 miles from Columbus in Hoching County, focuses on land used heavily for recreation. Sediment and acid mine drainage from abandoned surface and underground mines have severely degraded the water quality of the Hoching River and Hoching Creek. Reclamation includes grading, installation of drainage facilities, soil treatment and sediment retention measures, and revegetation.

Interior funds coal land projects

The Interior Department's Office of Surface Mining will provide $600,000 to reclaim an abandoned coal mine near Eagle Pass, Texas, which is located near a major housing development now under construction.

The funds will come from the federal share of reclamation fees collected from active coal mining operations as provided in the Surface Mining Control and Reclamation Act of 1977. Reclamation will include filling and permanently sealing the open shaft, burying the coal refuse material, grading to eliminate the steep slopes and gullies, and revegetating.

The office has also approved spending of $240,000 to reclaim an abandoned coal mine and power plant site at Gamerco, NM. The reclamation plan is very similar to the Texas operation and also designated as priority because of the danger to public health and safety.

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Crabgrass control and proper feeding in one application.

Tee Time 20-4-10 fertilizer gives you an unbeatable combination of nutrients and pre-emergence herbicides for healthy growth and control of crabgrass and other grassy weeds.

20-4-10 gets your grass off to a healthy start in the early Spring. The combination of available nitrogen, controlled release nitrogen, and sulfur in 20-4-10 *stimulates initial color response without excessive growth.* The controlled release nitrogen, derived from sulfur-coated urea, doesn't require high soil temperatures or bacterial action to start working. Sulfur-coated urea is unique in that it releases its entire nitrogen content during the same growing season to allow the grass full utilization of this major nutrient.

The 2:1 ratio of nitrogen to potash also contributes to the proven performance of Tee Time 20-4-10. The proper balance of potash aids the overall health of the grass, increasing resistance to drought, disease, and traffic.

To this carefully formulated product, we add Balan,® Betasan,® or Dacthal® to provide a winning combination for proper feeding and pre-emergence control of crabgrass and other grassy weeds. Pre-emergence products perform as well when combined with fertilizer as when applied separately, and sometimes even better. A one-step application can save you both time and labor.

Our 20-4-10 with Balan® and Dursban® goes even a step further by allowing you to add insect control to your feeding and weed-control program in a single application. That can mean even greater savings in time and labor.

You can switch to The Andersons' Tee Time products with confidence, knowing we spent 10 years developing and refining them. Try using one of our 20-4-10 crabgrass-control products as part of your overall program. One of them is just right for you.

Our distributors are qualified to assist you in determining which of these fine products best suits your needs. If your present supplier does not carry The Andersons' Tee Time products, call us toll-free or write and we'll give you the name of your nearest distributor. You'll be glad you did.

the professional's partner

The Andersons

Lawn Fertilizer Division
P.O. Box 119
Maumee, Ohio 43537
Ohio:
800-472-3220
Outside Ohio:
800-537-3370

Balan®
Trademark of Elanco Products Co., Div. of Eli Lily

Betasan®
Trademark of Stauffer Chemical Co.

Dacthal®
Trademark of Diamond Shamrock Corp.

Dursban®
Trademark of Dow Chemical Co.

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News *from page 60*

cally advanced to the presidency. He is supervisor of parks for Tenafly, New Jersey.

The new president-elect is Earl Wilson, vice president of Thornton-Wilson, Inc., Maineville, Ohio. Elected vice president was Fred Rigger, who is assistant manager in charge of grounds, Padonia Swim Club, Cockeysville, Maryland. Robert Fisher was re-elected treasurer.

The society will present its first area management workshop, "Business Management Techniques for Professional Grounds Managers," at the Holiday Inn in Jessup, Maryland, on February 18 and 19, from 9:00 a.m. to 4:00 p.m. For information and registration brochure, contact Allan Shulder, Executive Director, Professional Grounds Management Society, 7 Church Lane, Pikesville, MD 21208; telephone 301-653-2742.

TURF DISEASE

Bitter cold, drought may alter incidence

Exceptional cold winter temperatures and lack of rainfall in the Northeast may alter turf disease incidence, according to Cornell University turf pathologist Dr. Richard Smiley.

Lack of heavy snow cover and frigid soil temperatures should reduce the incidence of snow molds, says Smiley. However, lack of rainfall and snowfall over the past two years in the Northeast combined with irrigation may increase the incidence of Fusarium Blight, red thread, and dollarspot. Droughty soil combined with surface humidity from irrigation may make summer diseases more prevalent in the region.

Smiley anticipates an increase in summer turf diseases into the mid-80's due to continued drought conditions in the Northeast.

CENSUS

Farmland value doubles, irrigation more common

Between 1974 and 1978, the average value of agricultural land and buildings per acre increased from $336 to $627, according to the latest data from the Commerce Department's Bureau of the Census. The dependence on irrigation for agriculture increased in the same period to five percent of U.S. farmland.

Although the number of farms continued to decrease, the drop was less than in previous periods. The nation had one billion acres of productive farmland in 1978 in 2,480,000 farms, down 150,000 farms from 1974. There was an increase in the number of farms with less than 50 acres or more than 500 acres.

Farmers are turning to more efficient use of land and more control of available cropland. Acreage for pasture declined and irrigated acreage increased.

Orchard acreage increased ten percent and the number of orchards increase by a third. Possibly many of these new businesses were less than 50 acres.

Farmers chiseled away at wasteland by increased use of irrigation and decreased use of land for pasture. The net result was an increase in total cropland in 1978.

Continues on page 73

GROUND HOG EARTH DRILLS

Get the Job Done Quick and Easy!

There's a proven-dependable Ground Hog . . . with interchangeable auger sizes, blades and pilots . . . to suit your every need. Light in weight, easy to operate and requiring little maintenance, Ground Hog Earth Drills do the tough jobs quickly . . . with minimum, if any, downtime. Try one and see!

NEW MODEL D-5
with Special Clutch and Longer Life Engine
Manually controlled clutch stops auger rotation when operator releases clutch lever. Positive control allows operator to work with greater confidence and, therefore, greater efficiency. 5 HP engine for drilling in dense soil.

MODEL 82
with Big 8 HP 2-Cycle Engine
This model's powerful engine increases auger RPM and its heavy duty gear box assures continuous trouble-free operation. Only 75 pounds complete with 8" auger.

MODEL 1M
One-Man Drill
Cuts labor cost in half! Unique right angle drive line prevents torque kick-back. Drills close to walls and fences. 5 HP engine, manual clutch, highway rated 16" pneumatic tires for towing.

MODEL C-71-5
5 HP for Tough Digging
A large engine allows ample power in difficult conditions. Built-in ruggedness assures dependability and low maintenance.

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GOOSEGRASS

SILVER CRABGRASS

CROWSFOOT

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What you call it can't make it go away ...but Balan® can.

Depending on where you are, Goosegrass gets called a lot of things. But no matter where you are, nobody calls Goosegrass an early riser. It doesn't get up and get growing with regular crabgrass in early spring. Goosegrass waits to make its appearance until six to eight weeks after crabgrass germinates. And by the time you see it, there's not much you can do about it. But an application of Balan just before it begins to germinate is all it takes to put an end to your Goosegrass problems. Ask your Elanco distributor salesman to help you work out a full-course Balan program.

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a division of Eli Lilly and Company
Department E-455
Indianapolis, Indiana 46285

ELANCO

Balan®

News *from page 71*

MARKETS

Fertilizer producers up output by 5 percent

U.S. fertilizer producers increased production five percent above the previous year's five-month period of July-November, and almost equalled domestic disapperance of an unprecedented record fall in 1979, according to a report of The Fertilizer Institute.

"Nitrogen products remained the strong leaders in domestic disapperance for the five-month period," said Edwin M. Wheller, president of The Fertilizer Institute. "This product group showed a gain of five percent over July-November 1979, whereas all other product groups decreased in market movement."

Wheeler said that continued strong foreign demand for U.S.-produced fertilizers resulted in an increase of 30 percent for exports in the July-November period over 1979. This increase in exports applies broadly to each of the nitrogen, phosphate, and potash product groups. Nitrogen solution exports were more than twice last year's levels. Urea exports increased 58 percent, diammonium phosphate, 38 percent, and potassium muriate, 22 percent over year-ago levels for the five-month period.

NEW COMPANY

Irrigation consultant starts California firm

Harold W. Wake, a pioneer in the design and manufacture of low volume irrigation systems, has formed a manufacturing and marketing firm, Misti Maid, Inc., with a new line of home and garden irrigation systems.

Wake says the Misti Maid systems contain unique, advanced features, such as easy installation, great water and energy saving ability, adaptability to all terrain and uses, and the capability to fog, drip, mist, or sprinkle.

Art McNab Agency, Mountain View, CA, will be the manufacturer's representative for the firm in the West.

COURTS

Retailers unpaid for 2,4,5-T/Silvex products

Many retailers have not been paid for 2,4,5-T/Silvex products they returned to suppliers after the Enviromental Protection Agnecy's cancellation order in March, 1980.

Dow Chemical is still appealing the cancellation, but most formulators have agreed in the meantime to take back all supplies subject to EPA reimbursement. Retailers are entitled to cost plus a 15 percent handling charge.

While the EPA has admitted the validity and amounts of major claims, it has refused to pay for lack of funds. Lebanon Chemical sued the government in U.S. Court of Claims last June, and others are following. Favorable court judgments are expected within the next few months, and payment will then follow from court appropriations.

4 SOLID REASONS TO CHOOSE BUNTON.

Current contract numbers:
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1. Solid Construction. Bunton mowers are built with heavy gauge welded steel for dependability, durability and high performance.

2. Solid Savings. Bunton's diesel option provides longer engine life, lower maintenance and about half the fuel consumption of gasoline engines.

3. Solid Investment. Bunton mowers offer exceptional value to the professional who demands low maintenance and long service life from his equipment.

4. Solid Reputation. For over 30 years Bunton has satisfied the needs of its customers by building quality commercial mowers.

The 52 inch, self-propelled, diesel driven lawn mower shown above is one of 76 commercial rotary mowers built by Bunton. Select distributorships and dealerships available. Call or write for more information.

Bunton builds 'em better.

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A DIAMOND IN THE ROUGH.

You're a pro and it shows. Everything has to be just right—especially the equipment you use. That's why you'll want the Mitsubishi diamond on those rough jobs, where a tractor has to deliver.

Satoh Mitsubishi tractors deliver. Versatile, dependable and efficient; they deliver the highest amount of productivity at the most reasonable cost, the least amount of downtime and the kind of application flexibility you demand.

Satoh Mitsubishi tractors—they're as professional as you are.

For the name of your Satoh Mitsubishi dealer see your local Yellow Pages or write Satoh Mitsubishi, Box 5020, New York, NY 10150.

SATOH

MITSUBISHI

WE BUILD A BETTER TRACTOR

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EVENTS

The current issue of WEEDS TREES & TURF carries meeting dates beginning with the following month. To insure that your event is included, please forward it, 90 days in advance, to: WEEDS TREES & TURF Events, 757 Third Ave., New York, NY 10017.

2nd Annual Agri-Turf Irrigation Exposition and Technical Conference, Salt Palace, Salt Lake City, UT, **Feb. 15-18.** Contact The Irrigation Association, 13975 Connecticut Ave., Silver Spring, MD 20906, 301/871-1200.

National Arborist Association Annual Meeting, Sarasota Hyatt House, Sarasota, FL, **Feb. 15-19.** Contact Robert Felix, Executive Vice President, 3537 Stratford Road, Wantagh, NY 11793, 516/221-3082.

Capital Area Turf & Ornamental School, Lancaster Area, **Feb. 18-19.** Contact Harold E. Stewart, Dauphin County Cooperative Extension Service, 75 South Houcks Street, Suite 101, Harrisburg, PA 17109, 717/652-8460.

Maryland Nurserymen's Day, Maryland Flower Growers' Day, and Landscape Contractors Day, Center of Adult Education, University of Maryland, College Park, **Feb. 17, 18,** and **19.** Contact Conrad B. Link, Professor, Dept. of Horticulture, University of Maryland, College of Agriculture, College Park, MD 20742, 301/454-3606.

WSSA annual meeting, Dunes Hotel and Country Club, Las Vegas, NV, **Feb. 17-19.** Contact Weed Science Society of America, 309 West Clark St., Champaign, IL 61820.

Southern ISA chapter meeting, Sheraton Hotel, Charlotte, NC, **Feb. 22-25.** Contact Ervin C. Bundy, Executive Director, 5 Lincoln Square, P.O. Box 71, Urbana, IL 61801, 217/328-2032.

American Sod Producers Association Midwinter Conference, Harrah's, Lake Tahoe, NV, **Feb. 23-25.** Contact Bob Garey, ASPA Executive Director, 9th and Minnesota, Hastings, NE 68901, 402/463-4683.

Connecticut Groundskeepers Assoc. Conference, Hartford Civic Center, Hartford, CT, **Feb. 25.** Contact Connecticut Groundskeepers Assoc., P.O. Box 3916 Amity Station, New Haven, CT 06525.

Residential Landscape Design Short Course III, Fisher Auditorium, Ohio Agricultural Research and Development Center, Wooster, OH, **Feb. 25-27** Contact Fred Buscher, Area Extension Agent-Landscape Horticulture, Administration Building, OARDC, Wooster, OH 44691, 216/262-8176.

Penn-Del ISA chapter meeting, Holiday Inn, King-of-Prussia, PA, **Feb. 26-27.** Contact Ervin C. Bundy, ISA Executive Director, 5 Lincoln Square, P.O. Box 71, Urbana, IL 61801, 217/320-2032.

Southern ISA chapter meeting, Sheraton (not finalized), Charlotte, NC, **Mar. 1-4.** Contact Ervin C. Bundy, ISA Executive Director, 5 Lincoln Square, P.O. Box 71, Urbana, IL 61801.

Pennsylvania Turfgrass Conference & Trade Show, Hershey Lodge & Convention Center, Hershey, PA, **Mar. 2-5.** Contact Christine E. King, Executive Secretary-Treasurer, Pennsylvania Turfgrass Council, 412 Blanchard Street, Bellefonte, PA 16823, 814/355-8010.

The Irrigation Association Short Course, Pasco, WA, **Mar. 3-4-5.** Contact The Irrigation Association, 13975 Connecticut Ave., Silver Spring, MD 20906, 301/ 871-1200.

American Society of Agricultural Engineers symposium on "Engineering Systems for Forest Regeneration," North Carolina State University, Raleigh, NC, **Mar. 3-6.** Contact ASAE Headquarters, Dept. SESFOR, Box 410, St. Joseph, MI 49805, 616/429-0300.

Southeast Region Parks and Recreation Maintenance Operations workshop, Unicoi State Park, **Mar. 8-13.** Contact Charles Gregory, Recreation Advisor, Recreation Services Section, Georgia Dept. of Natural Resources, 270 Washington Street, S.W., Room 704, Atlanta, GA 30334.

The Irrigation Association Short Course, Lansing, MI, **Mar. 10-11.** Contact The Irrigation Association, 13975

Continues on page 76

Does the condition of your turf make you see red?

Switching to Pennfine Perennial Ryegrass could color your outlook. It's long been the standard of quality against which other varieties are compared. Why not simplify your life? Go with the most widely used fine-leafed perennial ryegrass in the nation. By the way, if you have trouble finding Pennfine, just ask the turf pro with the best-looking turf around. Chances are he's already using it. Pennfine Perennial Ryegrass, P.O. Box 923, Minneapolis, MN 55440

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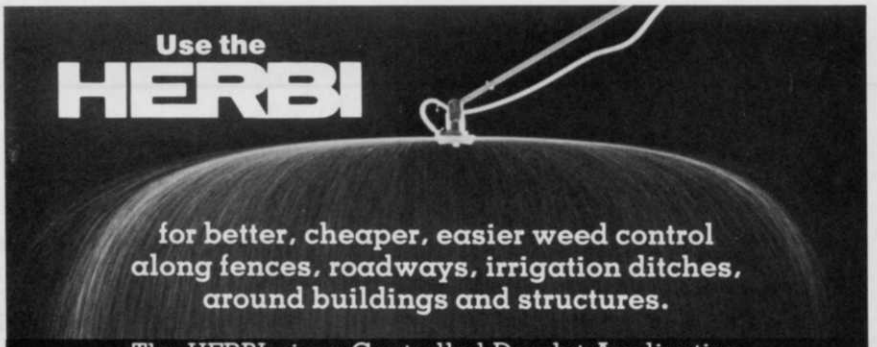

for better, cheaper, easier weed control along fences, roadways, irrigation ditches, around buildings and structures.

The HERBI gives Controlled Droplet Application . . . a revolutionary approach to the application of herbicides. Its spinning disc produces a consistent 250 micron droplet, meaning ultra low volume spraying, eliminating the need for high volumes of water. Gives exact and thorough coverage, with less chemical. Startlingly economical in cost and use.

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Events *from page 75*

Connecticut Ave., Silver Spring, MD 20906, 301/871-1200.

Northeastern Pennsylvania Turf & Grounds Maintenance School, Master Host Motel, Wilkes-Barre, PA, **Mar. 10-11.** Contact E.V. Chadwick, Luzerne County Cooperative Extension Service, Court House Annex, 5 Water Street, Wilkes-Barre, PA 18702, 717/822-1109.

Residential Landscape Design Short Course IV, Fisher Auditorium, Ohio Agricultural Research and Development Center, Wooster, OH, **Mar. 16-17.** Contact Fred Buscher, Area Extension Agent-Landscape Horticulture, Administration Building, OARDC, Wooster, OH 44691, 216/262-8176.

Hazardous Waste Management Conference, Stouffer's National Center, Arlington, VA, **Mar. 16-17.** Contact Robert W. Nash, executive director, The Energy Bureau Inc., 41 East 42nd Street, New York, NY 10017, 212/687-3178.

Continues on page 79

Warren's A-34 BenSun KENTUCKY BLUEGRASS

RATED FIRST

One bluegrass does it best.

Warren's A-34 BenSun bluegrass out-performed 43 bluegrasses during a 5 year independent study at 8 universities.

Whether it be density, texture, disease resistance, color, uniformity, wear and shade tolerance, hot-cool -dry or wet conditions, A-34 BenSun was superior in quality to all others.

A-34 blends well with other bluegrasses as well as fine leafed rye and fescues.

Do it now! Phone or write for proof of what we say.

Available as Seed and Sod

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Toro creates the ultimate low pressure, large radius Pop-Up.

Our new Toro Super 600 certainly lives up to its name: it's versatile, reliable and economical. And it's specially-designed to pass sand and silt right through it.

The Super 600 is also so remarkably compact, it's a breeze to install.

The New Toro Super 600

$19.95*

*Manufacturer's suggested list price subject to local dealer option.

We've re-invented irrigation, from the ground up.

TORO®

Irrigation Division

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FERTILIZE WITH ENVIRONMENTALLY RESPONSIBLE NITROFORM®.

UREAFORM NITROGEN

Overapplications of water soluble nitrogen may constitute a major source of nitrates in groundwater. This is called to your attention because golf courses and other ornamental turf are the single largest "crop" in many states.

AVOID NITRATE RUN-OFF.

Use fertilizer formulations with slow-release Nitroform 38%N to help reduce the problem of nitrate contamination. Use it not only on your greens and tees, but your fairways too. You can apply Nitroform less often, which saves labor and fuel. It also reduces costs.

NITROFORM® IS ECOLOGICALLY TRUSTWORTHY.

Nitrogen in Nitroform is held in reserve until turf can use it. Then it is released by bacterial action that increases as soil moisture and temperature increase. This is when turf needs and can use it. Nitroform should be an important element in every well-planned turf fertility program because it assures sustained, high-nitrogen feeding when used consistently.

INCREASE LATERAL GROWTH.

In recent tests on athletic fields, slow-release nitrogen increased lateral growth of turf rather than vertical growth. This increased turf density and resulted in fewer athletic injuries.

NO SALT BUILD-UP.

Water soluble nitrogens build up the salt level in your soil, which can eventually make it sterile. Nitroform will not build up the salt level.

LITTLE OR NO LEACHING.

University tests suggest that although water- soluble nitrogens may be cheaper on a pound-for- pound basis, it may be more economical to use slow release nitrogen products on turf because of leaching or volatilization of the water-solubles.

BE ENVIRONMENTALLY RESPONSIBLE. SPECIFY NITROFORM® IN YOUR TURF FORMULA... OR APPLY DIRECT.

Use Blue Chip® for dry applications; Powder Blue™ for liquid. Good for shrubs and trees, too. Call your turf supplier or write for more information.

THE QUALITY NITROGEN NITROFORM

THE LONGEST FEEDING HIGH ANALYSIS ORGANIC NITROGEN.

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Events *from page 76*

5th Turf Conference of Reinders Brothers, Inc., Waukesha Expo Center, Waukesha, WI, **Mar. 18-19.** Contact Ed Devinger, Reinders Brothers, Inc., 13400 Watertown Plank Road, Elm Grove, WI 53122, 414/786-3300.

Irrigation Association's Institute for Agricultural Irrigation, University of California-Riverside, **Mar. 23-Apr. 3.** Contact the IA, 13975 Connecticut Ave., Silver Spring, MD 20906.

The California Landscape Contractors Associations' second annual Landscape Industry Show, Convention Center, Long Beach, CA, **Mar. 26-27.** Contact Michael Leeson, CLCA, 1419 21st St., Sacramento, CA 95814, 916/448-2522.

Canada ISA chapter meeting, Holiday Inn City Centre, London, Ontario, **Apr. 1-3.** Contact Ervin C. Bundy, ISA Executive Director, 5 Lincoln Square, P.O. Box 71, Urbana, IL 61801, 217/328-2032.

International Symposium on Phytophthora, University of California—Riverside, **Apr. 1-4.** Contact Forrest D. Cress, University of California—Riverside, Div. of Agricultural Sciences, Riverside, CA 92521, 714/787-3332.

Annual Meeting of the American Boxwood Society, Blandy Experimental Farm, Boyce, VA, **May 14.** Contact The American Boxwood Society, Box 85, Boyce, VA 22620.

Second Annual Menninger Flowering Tree Conference, Quality Inn, Cypress Gardens, Winter Haven, FL, **May 14-15.** Contact Mrs. Taylor Burris, P.O. Box 16796, Temple Terrace, FL 33687, 813/985-8511.

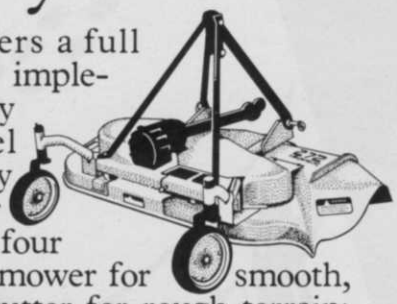
Western ISA chapter meeting, Sacramento Inn, Sacramento, CA, **May 17-20.** Contact Ervin C. Bundy, ISA Executive Director, 5 Lincoln Square, P.O. Box 71, Urbana, IL 61801, 217/328-2832.

Quebec ISA chapter meeting, Hotel Auberge des Gouverneurs, Sherbrook, Quebec, **May 21-23.** Contact Ervin C. Bundy, 5 Lincoln Square, Executive Director, P.O. Box 71, Urbana, IL 61801, 217/328-2032.

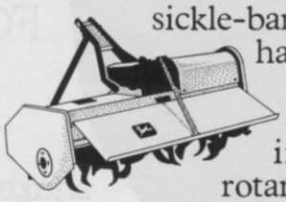
California Nurserymen's refresher course, Cal Poly, San Luis Obispo,

Continues on page 82

Even if you don't own a John Deere tractor, you can still have John Deere behind you.

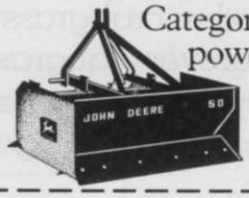


John Deere offers a full line of quality-built implements to fit nearly any make of small diesel tractor with a Category 1 3-point hitch. For example, there are four mowers: a grooming mower for smooth, even cuts; a rotary cutter for rough terrain; a flail mower for trashy conditions; and a sickle-bar mower for roadsides and hayfields.



For landscaping, John Deere has hitch-mounted implements including a rotary tiller, a box scraper, a rear blade and a post-hole digger. Of course, we also have a full line of hitch-mounted farm implements. So even if your tractor isn't green, you can make it do more when you put John Deere behind it.

For more information about John Deere Category 1 3-point hitch implements power-matched to small diesel tractors, see your John Deere dealer or send for a free leaflet.



To find out how John Deere implements can increase the versatility of your small diesel tractor with a Category 1 3-point hitch, send for a free descriptive folder. Mail this coupon to John Deere, Dept. B147, Moline, IL 61265.

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Nothing Runs Like a Deere®

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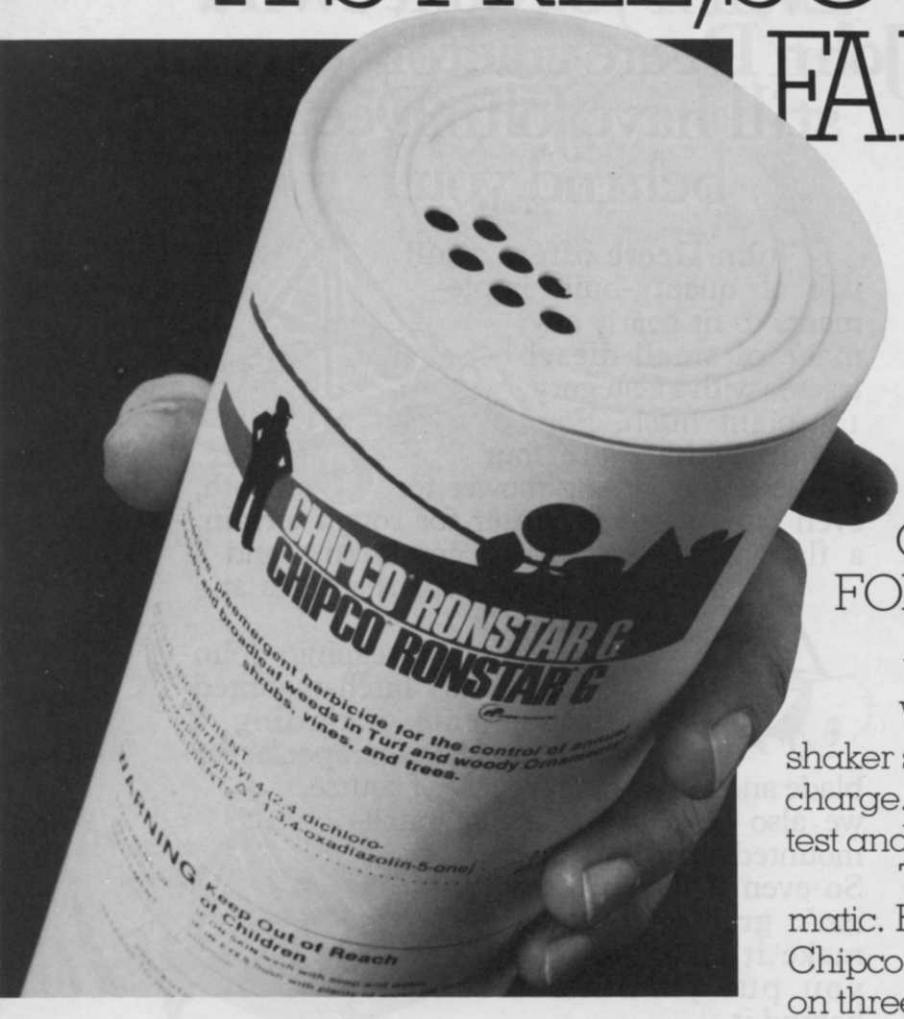
IT'S FREE, SO GIVE IT A FAIR SHAKE.



TRY EFFECTIVE, LONG-LASTING CHIPCO® RONSTAR® G, THE PREEMERGENT CRABGRASS HERBICIDE FOR TURF, GROUND COVER AND ORNAMENTALS.

We'd like to send you this 2¼-pound shaker sample of Chipco Ronstar G, at no charge. All we ask is that you put it to the test and check the results.

The test is simple. The results, dramatic. Following label directions, shake Chipco Ronstar G preemergent herbicide on three kinds of crabgrass troublespots. One in turf. One in ornamental plantings. And one in ground cover.

Observe that, unlike other crabgrass herbicides, Chipco Ronstar G can be used on all three. It goes wherever crabgrass goes, all over the landscape.

Then, as time goes by, note that wherever you put the Chipco Ronstar G, you're getting great control of crabgrass, goosegrass, and a broad spectrum of other problem weeds.

And then, if you like the idea of getting excellent, long-lasting crabgrass control with a herbicide that's so versatile it's foolproof, you won't mind paying for your next batch of Chipco Ronstar G. Fair enough? Rhône Poulenc Chemical Co., Agrochemical Div., Rhône Poulenc Inc., Monmouth Junction, NJ 08852. RHÔNE-POULENC

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Return this coupon, along with your business card or letterhead, for your free sample of Chipco Ronstar G.

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One sample per company.
Offer expires June 1, 1981.

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Please read label carefully, and use only as directed.

For day-in, day-out dependability...

Hire a Professional!

Because there's no time for down-time in the world of professional grounds and turf care, dependable equipment is a necessity. That's why MTD makes Lawnflite Professionals to last through years of continuous hard use...with minimum time out for maintenance.

Strength and durability are built into Lawnflite Professional mowers and tillers with heavy-duty components: handles that won't twist, throttles that don't bind, steel wheels with thick-wall tires, muscular industrial engines with Stellite exhaust valves and double-protection air cleaners.

Performance and convenient operation are part of all Lawnflite Professionals by design. Chain reduction drive gives the tillers quick response and gets the most out of every horsepower. All tiller controls are within arm's reach on or below the handles.

Lawnflite Professional mowers are equipped with extra-large, remote-mounted gas tanks and large-capacity grasscatchers that keep them mowing, with fewer stops for fill-ups and emptying. The mowers roll easily on big 8" wheels with heavy-duty sealed ball bearings, while exclusive "Ultra-Lift" blade design gives a clean, even cut. Convenient levers quickly adjust cutting height to any of five settings from ¾" to 3½". The Professional Model 618 mower offers all these features, plus the combined strength and light weight of a cast aluminum alloy deck. Professional Model 638 provides a wide 22" cut, and its true rear-discharge design means extra maneuverability and close-trim mowing next to trees, fences, and other obstacles... on both sides of the mower!

Behind every Lawnflite Professional are a full-year limited warranty and, even more importantly, the MTD heritage: 50 years of design and manufacturing excellence.

MTD

638
Model 111-638
22" Cut/Rear Discharge
Rotary Mower

LAWNFLITE
Professionals

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Model 111-618
20" Cut/Side Discharge
Rotary Mower

398
Model 211-398
5 HP/Chain Drive
Rotary Tiller

418
Model 211-418
8 HP/Rear Tine/Chain Drive
Rotary Tiller

Write today for color brochure with full specifications

MTD PRODUCTS INC P.O. Box 36900 Cleveland, Ohio 44136

Events *from page 79*

June 2-4. Contact Lanny E. Walker, public relations director, California Association of Nurserymen, 1419 21st Street, Sacramento, CA 95814, 916/448-2881.

Kentucky Cemetary Association annual meeting, Executive Inn, Louisville, KY, **June 5-7.** Contact Lewis C. Tingley, Resthaven Memorial Park, P.O. Box 18068, Louisville, KY 40218, 502/491-5950.

Grow Show '81, Albert Thomas Convention Center, Houston, TX, **June 8-10.** Contact David H. Lindsay, Exposition Manager, P.O. Box 17413, Dulles International Airport, Washington, DC 20041, 703/471-5761.

Texas ISA chapter meeting, Dunfey Dallas Hotel, Dallas, TX, **June 11-13.** Contact Ervin C. Bundy, Executive Director, 5 Lincoln Square, P.O. Box 71, Urbana, IL 61801, 217/328-2032.

New York State Nurseryman's Association Convention and Trade Show, Onondaga County War Memorial Convention Center, Syracuse, NY, **July 7-10.** Contact Margaret Herbst, 230 Park Ave., New York, NY 10017, 212/685-4579.

American Sod Producers Association Summer Convention & Field Days, Hershey Motor Lodge & Convention Center, Hershey, PA, **July 15-17.** Contact ASPA, Bob Garey, Executive Director 9th & Minnesota, Hastings, NE 68901, 402/463-4683.

International Society of Arboriculture Annual Meeting, **Aug. 9-13,** Boyne Mountain Resort, Boyne Falls, Michigan. Contact E.C. Bundy, 5 Lincoln Square, P.O. Box 71, Urbana, IL, 61801, 217/328-2832.

Sixth Nebraska Turfgrass Field Day and Equipment Show, Aug. 4. Contact Dr. Robert Shearman, University of Nebraska, 377 Plant Science Bldg., Lincoln, NE 68583, 402/472-2550.

University of Rhode Island Turfgrass Field Day, Kingston, RI, **Aug. 26.** Contact C.R. Skogley, University of Rhode Island, Dept. of Plant Science, Woodward Hall, Kingston, RI, 02881, 401/792-2570.

Continues on page 85

Does your turf make your reputation good as gold?

It does if it's seeded with Pennfine Perennial Ryegrass. Since its development by Penn State University in 1970, Pennfine has become the number one selling fine-leafed perennial ryegrass in the nation. And the thousands of turf professionals who continue using Pennfine are the biggest vote of confidence. You'll find top-quality Pennfine competitively priced and in ready supply. Pennfine Perennial Ryegrass, P.O. Box 923, Minneapolis, MN 55440

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WHEELED BLOWER
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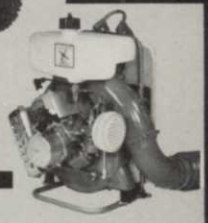
a portable airblast that cleans up fast everywhere.



NO DRIFT HERBICIDE APPLICATOR
roller flattens weeds to deposit chemicals over greater leaf surface for better, quicker kill. No spray, no drift!

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gives fast, even coverage. Sprays 25 ft. up. 3 gal. tankful covers 1 acre in 15 min.

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chips up to 3" diam. wood with drum type rotor. 11 to 16 HP models.

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broadcasts sand, salt, seed and all fertilizers to 60 ft. swath. Holds 7 to 20 cu. ft.

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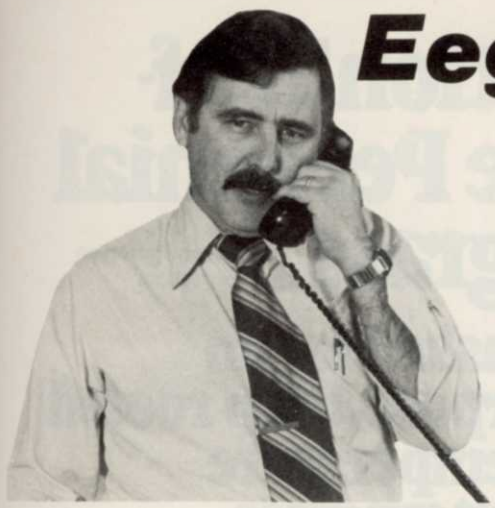
"I recommend the Morbark Eeger Beever...



...It's a safer machine to operate and keeps the operator out of the street. Knives cost less than half of conventional brush chippers and can be changed in less than 15 minutes. Fuel consumption can be cut in half and the Morbark Eeger Beever will provide greater longevity and a shorter payback."

Ken Thompson, Director
Dept. Public Works, Howell, Michigan

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- CHIPS TREES AND LIMBS UP TO 12" IN DIAMETER
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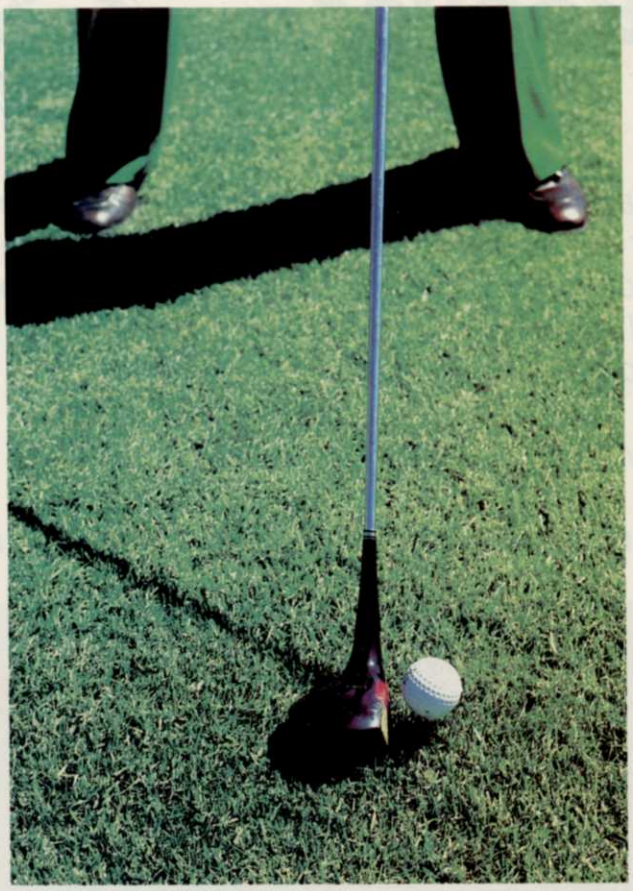

Citation Turf-Type Perennial Ryegrass

Plant Variety Protection Number 7500003

...you asked for an all-purpose, deep rooted high temperature tolerant ryegrass...

This is our answer!

This unretouched photo from California demonstrates an advantage of including 20% Citation with an improved blend of bluegrasses. On the left is 100% Kentucky bluegrass damaged by Fusarium blight. On the right the Citation-bluegrass mixture shows little or no damage.

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Jonathan Green & Sons
Farmingdale, NJ 07727
Turf-Seed, Inc.
Hubbard, OR 97032
J & L Adikes, Inc.
Jamaica, NY 11423

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Events *from page 82*

Garden Industry of America Conference & Trade Show, Pittsburgh Convention/Exposition Center, Pittsburgh, PA, **Sept. 12-14.** Contact GIA, Box 1092, Minneapolis, MN 55440.

Pacific Horticultural Trade Show, Long Beach Convention Center, Long Beach, CA, **Sept. 23-25.** Contact Lanny E. Walker, public relations director, California Association of Nurserymen, 1419 21st Street, Sacramento, CA 95814, 916/448-2881.

Central Coast Turf Day, California Polytechnic State University, San Luis Obispo, CA, **Oct. 1.** Contact Ronald D. Regan, Head, Ornamental Horticulture Department, CPSU, San Luis Obispo, CA 93407, 805/546-0111.

Northern Michigan Turf Managers Association meeting, Pinconning, MI, **Oct. 6.** Contact C. E. "Tuck" Tate, President, NMTMA, 1147 Santo, Traverse City, MI 49684, 616/947-9274.

Southern California Turfgrass/ Landscape Equipment & Material Educational Exposition, Costa Mesa, CA, **Oct. 14-15.** Contact Ed McNeill, Southern California Turfgrass Council, 1000 Concha Street, Altadena, CA 91001, 213/798-1715.

Southwest Turfgrass Association Annual Conference, Albuquerque, NM, **Oct. 15-16.** Contact Arden Baltensperger, Southwest Turfgrass Association, New Mexico State University, Agronomy Dept., Box 3-Q, Las Cruces, NM 88003, 505/646-3138.

Florida Turf-Grass Association 29th Annual Conference and Show, Orlando, FL, **Oct. 18-22.** Contact Beth Eyman, FTGA, 1520 Edgewater Drive, Suite E, Orlando, FL 32804.

C.A.N. Convention, Ventura Holiday Inn, Ventura, CA, **Oct. 20-22.** Contact Lanny E. Walker, California Association of Nurserymen, 1419 - 21st Street, Sacramento, CA 95814, 916/448-2881.

Interior Plantscape Association Annual Meeting, Radisson St. Paul Hotel, St. Paul, MN, **Oct. 28-30.** Contact IPA, 11800 Sunrise Valley Drive, Reston, VA 22091, 703/476-8550.

National Institute on Park & Management meeting, Appleton, WI, **Nov. 1-6.** Contact NIPM, Box 1936, Appleton, WI 54913, 414/733-2301.

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Charles Duell, Bush Hog Engineer

When your customers need a rugged cutter that leaves grass looking like a green carpet, recommend a Bush Hog® TM Cutter. TM blades whirl about 20% faster than many competitive models. That means smoother, cleaner cutting. And greener lawns because grass tips that are cut clean stay green.

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If you're ready to give your dealership the Green Profit Treatment, write for free literature on the TM Cutters from Bush Hog.

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How to choose the right iron.

Choosing the right golf club is a serious matter. You need one that's just right for the shot you have to make. You should take into account the distance, wind, lie, and obstacles.

At Kubota, we feel that you should devote the same careful attention to choosing a tractor.

YOU WOULDN'T TEE OFF WITH A BASEBALL BAT.

And you wouldn't want to get the wrong tractor for the jobs you have to do.

Whether you take care of a golf course, an estate, a campus, a park, or do roadside maintenance, you want a tractor that's versatile. Can it handle a mid-mount mower? A gang mower? Can it move dirt? Dig a hole? Kubotas can do all these things. Every Kubota has rear PTO and a 3-point hitch that can accommodate a wide variety of implements. You don't want a tractor so specialized it can do only one job.

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KUBOTA. THE MID-SIZE TRACTOR.

Our tractors range from 12 to 81 horsepower. Small enough for economy, large enough for heavy-duty jobs. It's wasteful to use 100 horses for some mowing. And it's impossible for 10 horses to do heavy moving or hauling.

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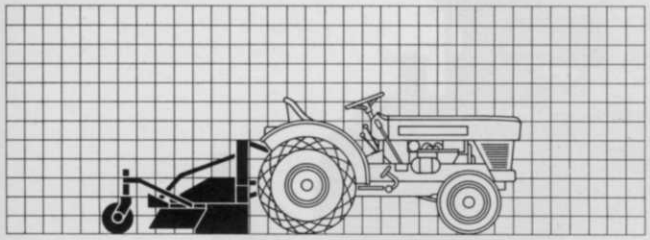
At Kubota, we've been making diesel engines for 30 years. In fact, all our engines are diesels.



Rear-mount mowers or rotary cutters are available for all Kubota tractors.

Diesel engines are rugged and durable. They have no electric ignition system, so they never need a tune-up. And running a Kubota diesel engine costs a lot less than running a comparable gasoline engine.

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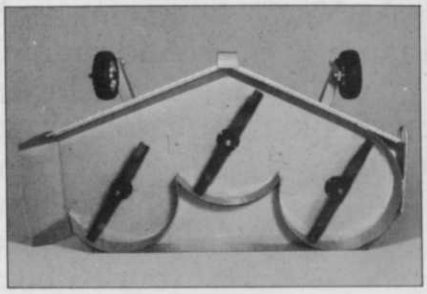
Now, the Cushman Front Line offers a choice of decks. And a diesel.

We've taken a proven performer and made it work even harder. You already know the Front Line™ as an exceptional rotary turf mower. With the kind of common-sense engineering and durability you expect from Cushman.

Durability that comes from features like an 18 hp, air-cooled OMC gasoline engine. Single, rear-wheel steering and split, front-wheel traction assist pedals. Variable cutting heights. Hydraulic deck lift. Foot and parking brakes. Large-capacity fuel tank. Wheel-type steering, and more.

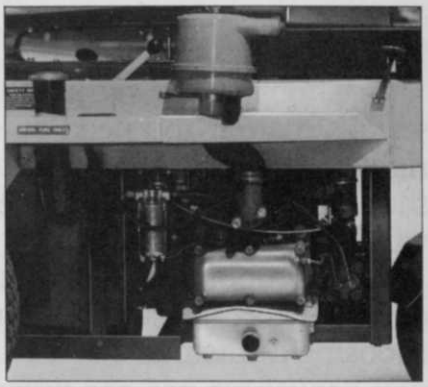
And now, optional decks, diesel power and specialized accessories make it even more productive.

In addition to the 72" mower deck, we now offer a 60" deck for smaller jobs. Both feature 12-gauge carbon steel construction, and are offset for close-up trimming.



For even greater economy and durability, the Front Line is now available with an optional water-cooled 4-cycle, 2-cylinder diesel engine.

And for year-round versatility, we've added hard-working optional accessories for the gas tractor. Like the new 60" chain-driven rotary broom. The roll-over protection structure and weatherproof cab set (also available for diesel). And the



new 48" snow thrower that can move up to 5,000 lbs. of snow per minute.

The Front Line. Tough enough to be a Cushman. Now versatile enough to pay off full time.

Call your Cushman dealer now for a demonstration.

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Ditch Witch has introduced the V250 lawn plow, a compact, 25-hp. vibratory plow. The V250 can make underground

installations of cable, plastic pipe, and other lines for water, power, and residential sprinkler systems. Its drive and plow lift systems work efficiently and dependably.

Write No. 701 on reader service card

Video Computerized System, Central Model 39500 has a video terminal with standard typewriter keyboard and a computer that can be located in a desk or wall mounted. It offers programming at the central terminal or from the field controller and total program displays on the video screen for fast change or review.

The system, from Royal Coach Sprinklers, has valves that can be programmed from 0 to 60 minutes in one-minute increments or 1 to 9 hours in one-hour increments. Automatic independent syringe program, 70 irrigation groups, and built-in rechargeable battery are other features.

Write No. 702 on reader service card

A 19 HP Wisconsin Diesel engine has been added to Bunton's rotary tractor line. This air-cooled engine has a forged crankshaft, cast iron cylinder, and die-cast aluminum crankcase. Its fuel injection pump is automatically reset by the governor for quick starts.

The tractor designed for the engine is made of 11- and 7-gauge steel and steered by a single rear wheel for a

shorter turning radius. A self-adjustment belt-tightening system helps prevent belt slippage in high, tough grass. Optional attachments include 71-inch and 61-inch out-front decks and a cab for the operator's comfort.

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Continues on page 91

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Sprayer Pump Handbook

New Edition!

8 pages of helpful information to help you select and use your pumps better. Hookup diagrams for piston, roller and centrifugal pumps. Graphs of pump outputs, flow through spray nozzles. Data on pump and sprayer component selection plus much more. Send for your free copy now.

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This single cylinder, medium pressure sprayer features a trailer hitch for attachment to garden tractors. It also comes with orchard gun which adjusts from steady stream to fine mist. The sturdy polyethylene tank is noncorrosive and lightweight.

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TEXTRON

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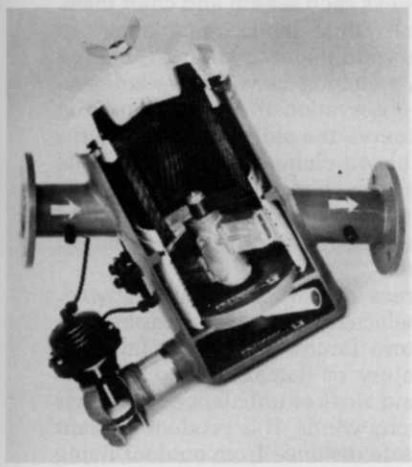
Products *from page 89*

Six Filtomat filters, offered by Global, range in inlet diameter from 3 to 12 inches and in flow rate from 110 to



2,630 gallons per minute. All operate at 30 to 150 psi and are self-cleaning.

Each model comprises a two-compartment filtering system. In the upper compartment, water passes through a perforated plastic cylinder that acts as a

Continues on page 94

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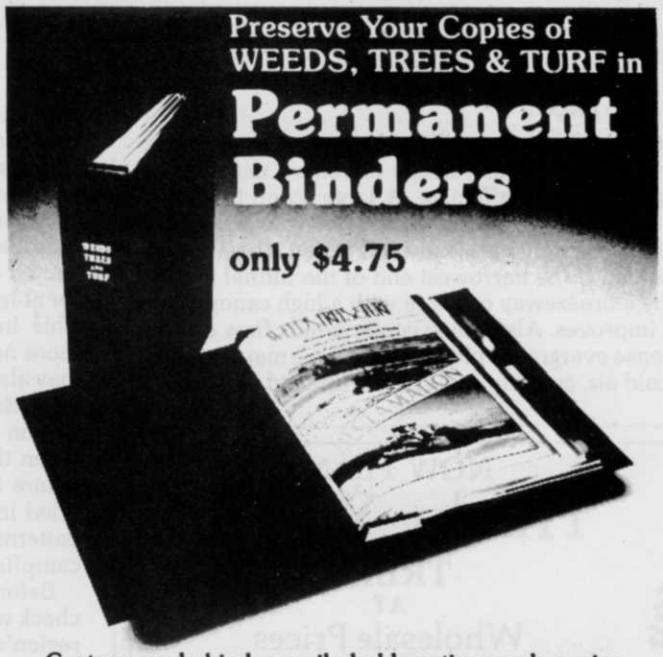

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Energy *from page 21*

conditioning." Because of the Venturi effect, as the funnel narrows, wind velocity increases, making the arrangement more effective. A large scoop that contracts in breadth can increase the velocity of prevailing winds that are light but steady and would otherwise be ineffectual. If the narrowest end of the funnel is covered by a breezeway or a tree with a high canopy, the effect improves. Also, since cooler winds flow downhill, dense evergreens planted on a slope may trap and hold cold air, creating cool spaces, upwind of the barrier.

Effective wind controls demand careful analysis of the direction and strength of the prevailing winds at different seasons.

To learn the direction of all air movements, tie strips of cloth on several posts, five or six feet tall. Anchor them securely at all compass points, plus any suspected odd wind pockets. Study the wind movements for at least several weeks each season and chart them. This information will guide landscaping plans. In more northern areas, wind patterns around buildings may also be traced by watching the way snow is deposited. Make your first observation after a fresh snow on a calm day. Later observe the shift in snow patterns when the wind has blown channels and paths. Note where the ground is bare, and where the snow has piled in drifts. A third method for determining wind patterns is to study smoke released from a chimney, campfire, or barbecue.

Before planting trees or shrubs to control wind, check whether your selected species can withstand the region's strongest storm forces. Trees may fall onto buildings, causing injury or damage. Keep all trees pruned. Deadwood and weak or unbalanced branches are vulnerable to strong winds. It is prudent to plant soft-wooded trees a safe distance from outdoor living areas and buildings if possible. Generally, the fast-growing trees such as pine (*Pinus* species) and larch (*Larix* species) have soft woods and are weaker. Silver maples (*Acer saccharinum*), poplars (*Populus* species), willows (*Salix* species), and black cottonwoods (*Populus trichocarpa*) are especially susceptible to breakage. **WTT**

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TREES
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Colorado Blue Spruce plus 26 other evergreen varieties; Black Walnut plus 28 other deciduous trees including many hardwoods. Ideal for forestation, windbreaks, wildlife shelter and food, soil conservation . . . increase property value. Low quantity prices. **Also new Hybrid Poplars.**

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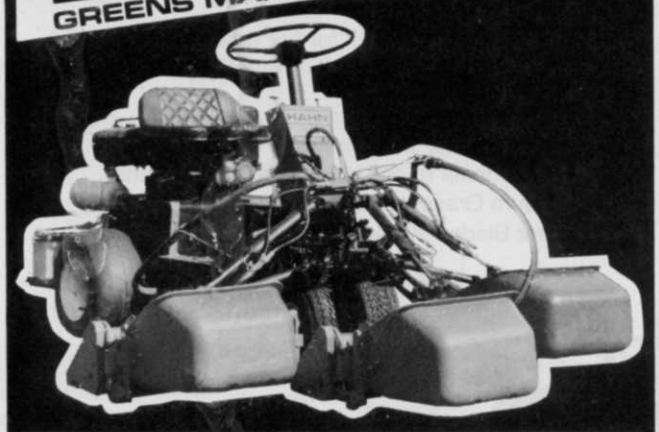

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Get the complete greens management system or order units as you require.

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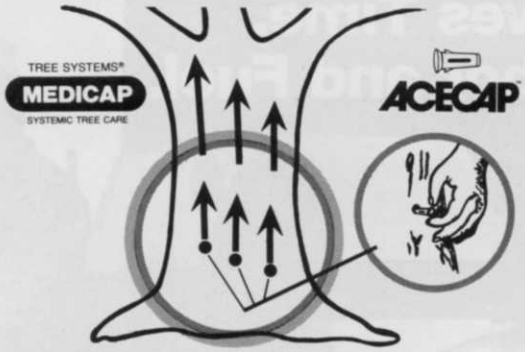

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ACECAPS contain orthene® a "new generation" insecticide for environmentally acceptable control of many destructive tree pests.

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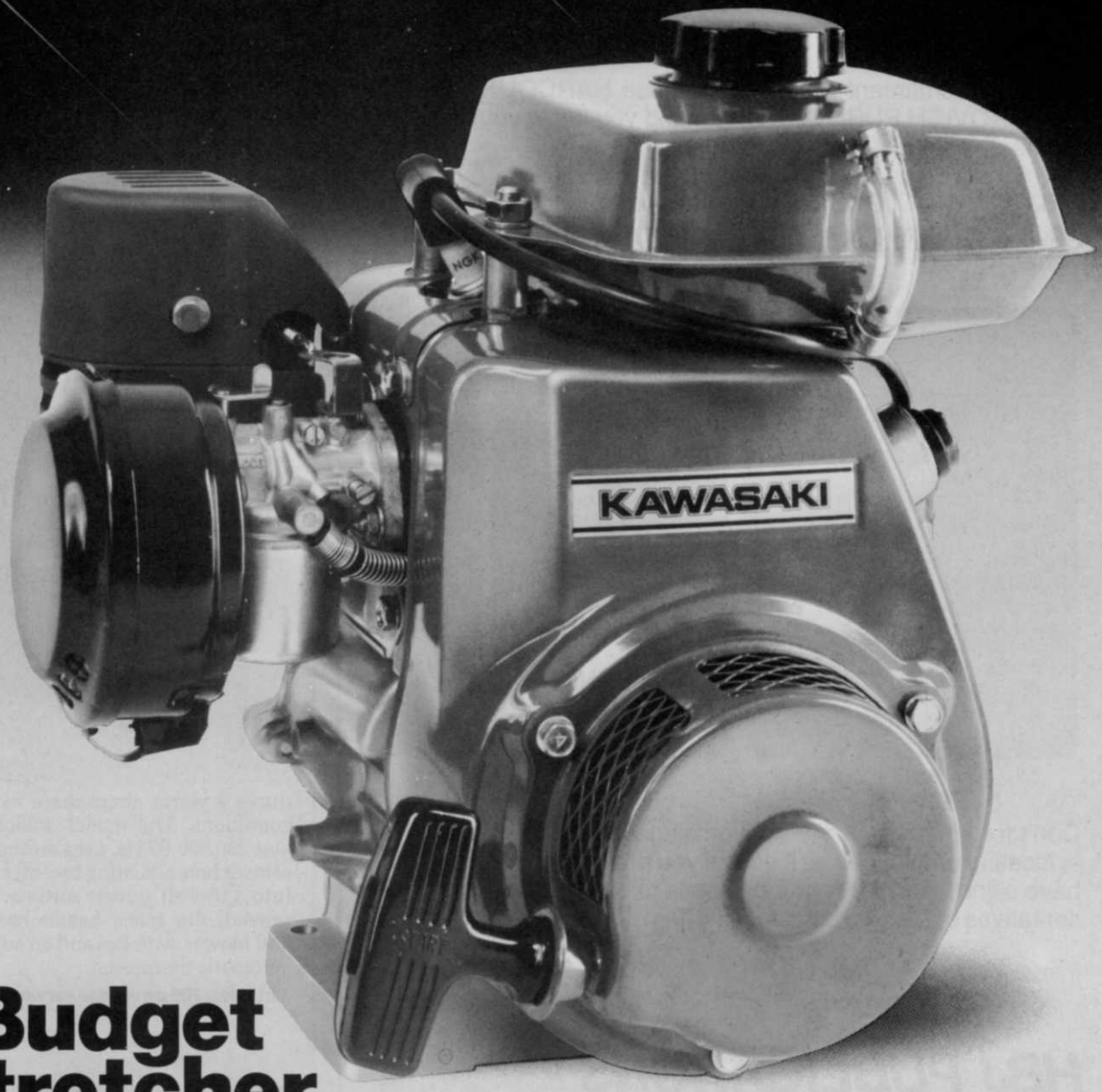
Kawasaki



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Drug & Cosmetic Industry	7500	Neurology	12032
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Fast Service	50537	Pest Control	14498
Flooring	22000	Professional Remodeling	32995
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Hearing Instruments	16592	Rent All	11139
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		Toys, Hobbies & Crafts	13607
		Weeds Trees & Turf	42677

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Call Dawn Anderson at 218-727-8511

Products *from page 91*

coarse grid. In the lower one, a second cylinder, lined with a fine corrosion-resistant screen, can filter both sand and algae.

Write No. 704 on reader service card

Portable space heater model 230 from the Hotsy Corporation, circulates 2,500 cubic feet of heated air every minute. Wide-angle, squirrel-cage blower pro-

duces a warm atmosphere in subzero conditions. The model, which generates 230,000 BTUs, uses ordinary kerosene or home-heating fuel oil and plugs into 110-volt power outlets. UL approved, the space heater has burner and blower switches and an adjustable, automatic thermostat.

Write No. 705 on reader service card

Bermuda grass planter puts down roots, sprigs, rhizomes, or cuttings close to walls, curbs, and buildings. This Bermuda King model plants a 30-inch

Continues on page 96

Write **118** on reader service card

Perfect Partners

IBDU and Sulfur Coated Urea

A new concept in slow release fertilizers to give you high performance at an economical cost.

Now you can get all the performance of a slow release fertilizer at a cost lower than most other professional fertilizer products.

New IBDU/SCU™* mixes combine three nitrogen sources—IBDU, Sulfur Coated Urea and Urea—to give your turf short, intermediate and long nitrogen release. This three-stage release results in a constant, even rate of turf feeding that lasts for up to 90 days.

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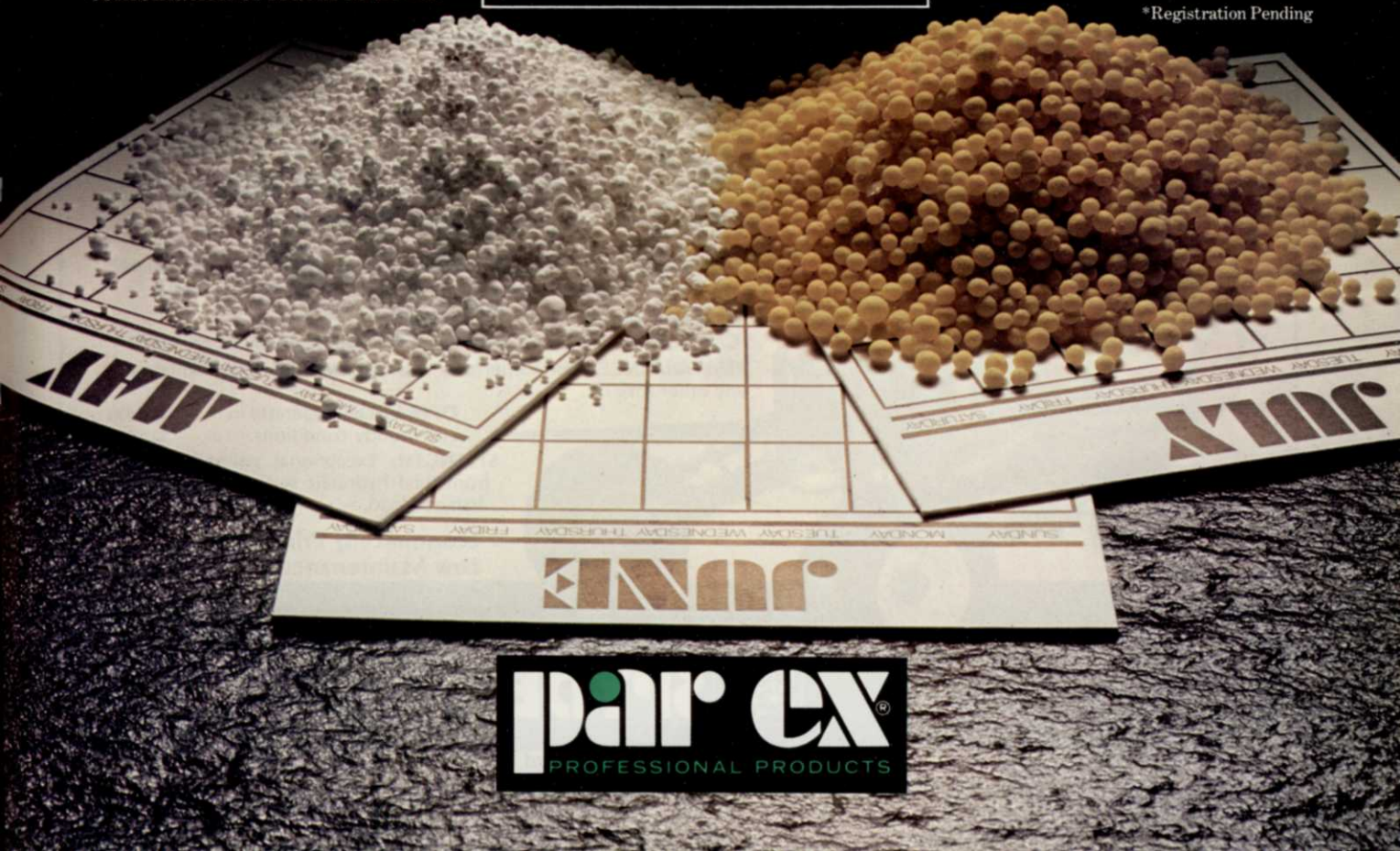
A First for Turf

New IBDU/SCU fertilizer mixes can provide your turf a combination of features never before available in a single fertilizer. It gives your turf all the benefits of IBDU, the highest performance slow release nitrogen available, with the proven benefits of a high quality prilled Sulfur Coated Urea. Plus, there's water soluble urea to get your turf off to a fast, green start. IBDU/SCU fertilizers are available in a variety of complete mixes, custom formulated to regional turf requirements.

See your local distributor or PAR EX representative about the new IBDU/SCU fertilizer mixes. They just might be the perfect partner for your fertilizer budget.

Estech General Chemicals Corporation,
Professional Products Division,
P.O. Box 1996 Winter Haven, FL 33880

*Registration Pending

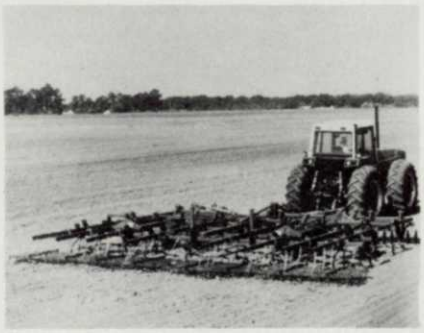


par ex®
PROFESSIONAL PRODUCTS

wide swath and packs plantings firmly in one operation. The machine will also feed, separate, and plant sod. It is compact, maneuverable, and easily trailered from job to job.

Write No. 706 on reader service card

Soil Conservur from Bush Hog prepares seedbeds with a combination of disc blades, field cultivator shanks, and spike mulcher teeth. By applying and mixing chemicals in one pass, it eliminates two or more trips over the field. Available in two rigid and three wing



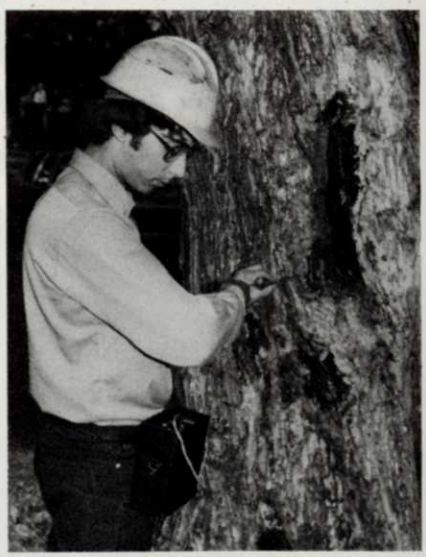
models, the machine includes a flip-over hitch with a clevis on one end and a pintle hitch on the other; hand ratchet level adjustment; two spring cushioned front disc gangs set at a 10-degree angle; and 18-inch disc blades with 7½-inch spacing.

A 40-inch space between disc blades and field cultivator shanks allows flexibility in applying chemicals. No dirt shields are required. Shanks mix chemicals with soil and are equipped with a shank holder for ease of assembly, lighter weight, and durability.

Write No. 707 on reader service card

The digital Shigometer, supplied by the Osmose Wood Preserving Company of America, provides an accurate means of detecting discoloration and decay in trees. With a little training, personnel can quickly determine the exact amount of decay present. In addition, trees can be rapidly indexed for growth rate.

The instrument works by measuring the resistance of wood to a pulsed electric current. As wood decays, its electrical resistance decreases so when the



probe's tip contacts decayed wood, readings change dramatically. The Shigometer weighs less than two pounds, making it convenient for checking remote timber stands.

Write No. 708 on reader service card

Continues on page 98

Write **158** on reader service card

Write **107** on reader service card →

ORTHENE–INSECT PROTECTION AT ITS BEST.

ORTHENE® Tree & Ornamental Spray is a giant step forward in protection. It kills a wide range of insects, on contact and with a lasting residual action. In fact, it's probably the only insecticide you need.

Here are some of the insects it kills; aphids, bagworms, birch leafminer, tent caterpillar, Douglas Fir tussock moth larvae, gypsy moth larvae, webworms, scales, California oakworm, spring and fall cankerworms, Nantucket pine tip moth larvae, and adult root weevil.

NEW FROM ORTHO

A companion product from ORTHO is ORTHOMITE™ Ornamental Miticide. It's the perfect solution for mite problems on flowers and ornamentals.

AVOID ACCIDENTS: For safety, read the entire label including precautionary statements. Use all chemicals only as directed.

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ORTHO PRO

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Company _____

Street Address _____

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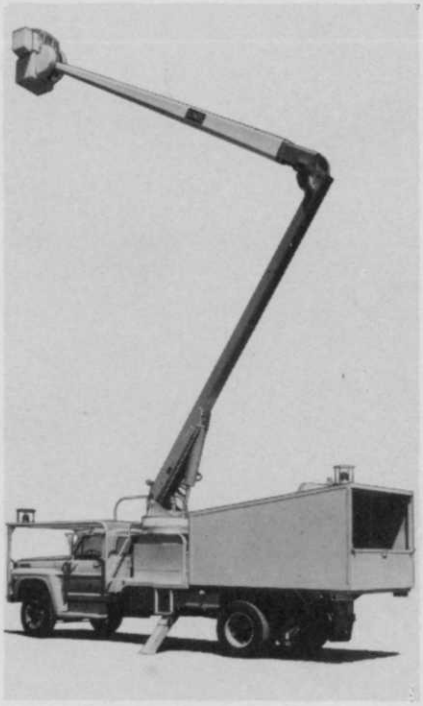
Mail to: R. G. Gras, Chevron Chemical Company, 575 Market Street, San Francisco, California 94105

Equipped with Hi-Ranger chip boxes, Hustler II series 4FI and Linesman II Series 5FI Hi-Ranger aerial manlifts suit trimming and clearance work by



utilities, tree service contractors, and municipalities. Box sizes of 7½, 9, and 12 cubic yards provides versatility. Boxes feature short, flatbed sections that extend under tower pedestals, hinged tailgates, hydraulic dump, lighting and reflective equipment to comply with government codes. Mobile Aerial Towers makes the Hustler II Series to extend 45 feet and the Linesman II Series to extend to 57 feet.

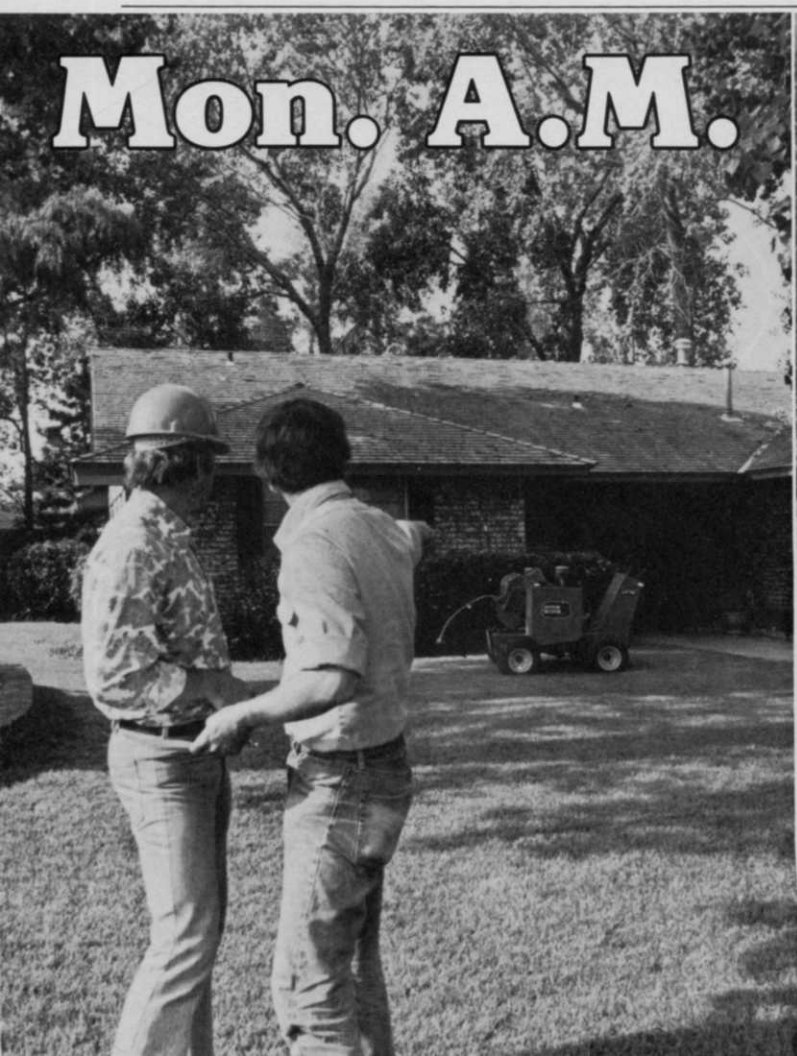
Write No. 709 on reader service card

ESI-ATOR, a biocatalytic ferment made by Environmental Stabilizers International, improves growth on hardpan, compacted, and clay soils. It opens and aerates the soil, provides better penetration and retention of moisture, and activates fertilizer, thereby facilitating new growth and revitalizing older vegetation. The conditioner can be used on lawns which have been planted in difficult soil or on golf courses and city parks.

Write No. 710 on reader service card

The G-20 utility tractor features a broad power range, hydrostatic steering, and fuel economy. A 152.7 cubic inch diesel engine on this Jacobsen tractor produces 45 hp. at 2250 rpm and 119 foot pounds torque at 1300 rpm. Operators can easily match capacity to

work with its six-speed (plus reverse) transmission. Power range for the G-20's PTO is 30 to 42 hp. at 2250 rpm. Flotation tires roll over moist areas with little turf damage or loss of traction. Operator controls include a tachometer



and hourmeter; fuel, ammeter, oil pressure, and engine temperature gauges; and safety starter switch.

Write No. 711 on reader service card

Mini-mixer from Bradley will mix a 90-pound bag of cement or mortar with water in 90 seconds. The portable mixer is hand-powered and has three heavy-gauge, removable blades and a two-position steel stand. It will also mix

paint, seeds, fertilizer, potting soil, insecticides, stucco, mulch, feeds, and chemicals.

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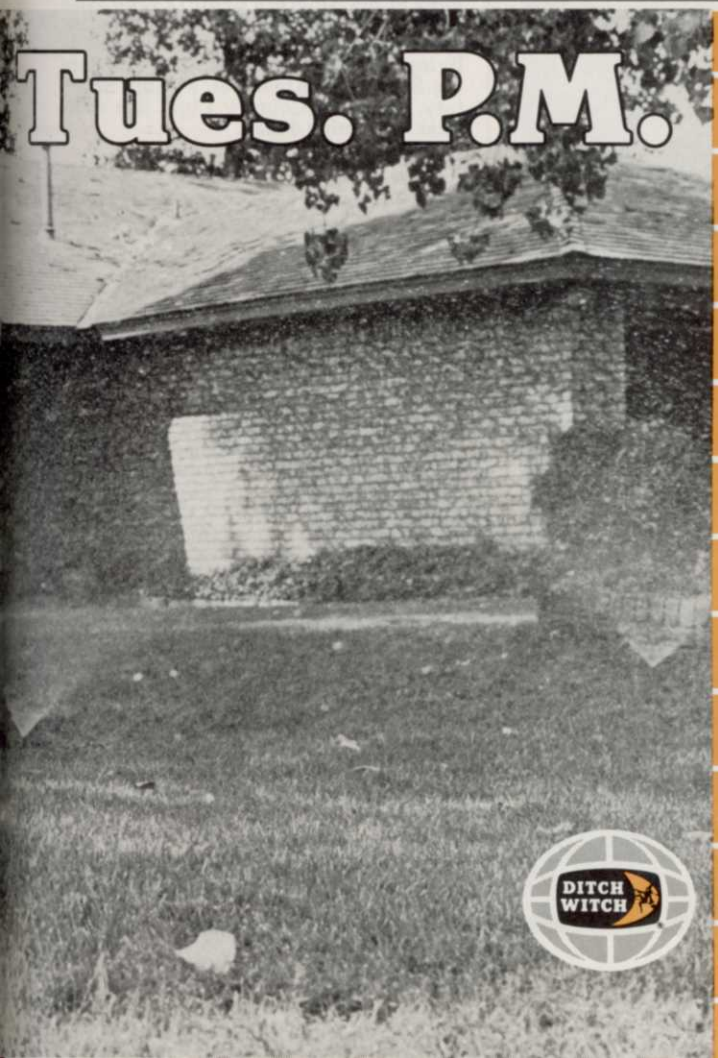

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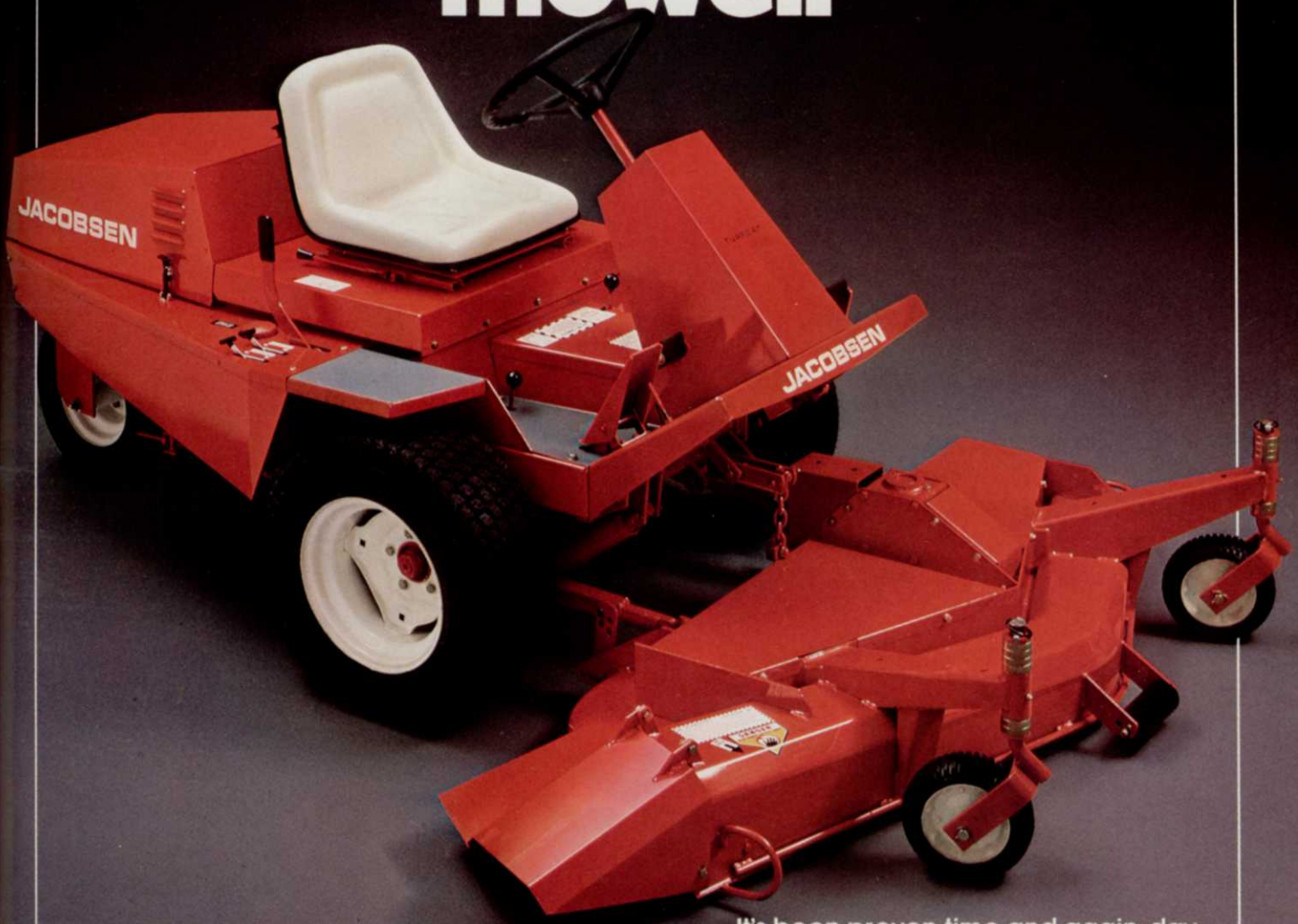

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